VOL. 6 NO. 7
April 15, 1981

Energy Research Abstracts

ABSTRACTS 8525-10078

Technical Information Center
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications which are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the energy data base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below.

PUBLICATIONS OF THE TECHNICAL INFORMATION CENTER

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize the following: programmatic efforts; legislative, regulatory, and other legal aspects; social, economic, and environmental impacts; regional and sectoral analyses; institutional factors, etc. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; domestic subscribers $3.00, foreign $3.75 per copy; annual cumulative index, domestic $4.00, foreign $5.00 per copy. The annual subscription price is $38.00 for domestic subscribers and $47.50 for foreign subscribers.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. Indexes are cumulated semiannually and annually. *ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues including a semiannual index and an annual index is $184.00 for domestic subscribers and $230.00 for foreign subscribers. The semiannual and annual indexes will also be available separately to subscribers. The cost for the semiannual index is $18.00 (domestic) or $22.50 (foreign); the annual index is $33.00 (domestic) or $41.25 (foreign). A single issue costs $5.55 (domestic) or $6.95 (foreign).

The following publications are available to the public on a subscription basis from the National Technical Information Service (NTIS), Springfield, Virginia 22161. The annual subscription rate for one volume (calendar) year (12 issues plus cumulative index) is $45.00 for domestic subscribers and $90.00 for subscribers outside the North American Continent. A single issue is $6.00 (domestic) and $12.00 (outside the North American Continent).

Current Energy Patents (CEP)

A monthly publication providing abstracting and indexing coverage of the international patent literature, including patent applications, that concerns any aspect of energy production, conservation, and utilization. Available as PB81-902800.

Energy Conservation Update (ECU)

A monthly abstract journal devoted to current information on energy conservation in buildings, transportation and propulsion, and industry; waste processing plants and equipment; energy storage; energy conversion; advanced automotive systems; combustion systems; power cycles; synthetic fuels; and power transmission. Available as PB81-914800.

Energy and the Environment (EAE)

A monthly abstract journal devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment. Available as PB81-914900.

Fossil Energy Update (FEU)

A monthly abstract journal devoted to information on the processing and use of fossil fuels. Available as PB81-914600.

Fusion Energy Update (CFU)

A monthly abstract journal devoted to information on controlled thermonuclear research. Available as PB81-915300.

Geothermal Energy Update (GEU)

A monthly abstract journal devoted to information on the exploration and development of geothermal resources. Available as PB81-914700.

Solar Energy Update (SEU)

A monthly abstract journal devoted to information on the utilization of solar, tidal, and wind energy. Available as PB81-914500.

Synthetic Fuels Update (SFU)

A monthly abstract journal devoted to information on coal gasification; coal liquefaction; other coal processing; biomass conversion to fuel; shale oil and tar sand bitumen production; hydrogen fuels; other hydrocarbon fuels; alcohol fuels; and inorganic hydrogen compound fuels. Available as PB81-902700.

INTERNATIONAL ENERGY PUBLICATIONS

Atomindex (Published in cooperation with the Technical Information Center by the International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria)

A semimonthly abstract journal devoted to information on nuclear science and technology. Through an exchange agreement, IAEA/INIS provides all non-U. S. nuclear information of *Atomindex* to TIC for inclusion in the DOE/RECON Data Base; in turn, TIC provides all U. S. nuclear information to IAEA/INIS for inclusion in *Atomindex*. *Atomindex* is available by subscription from UNIPUB, P.O. Box 433, Murray Hill Station, New York, NY 10016. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $150.

Coal Abstracts (Published in cooperation with the Technical Information Center by the International Energy Agency, IEA Coal Research, London, England)

A monthly abstract journal devoted to information on coal. Through an exchange agreement, IEA Coal Research provides all non-U. S. coal information of *Coal Abstracts* to TIC for inclusion in the DOE/RECON Data Base; in turn, TIC provides all U. S. coal information to IEA Coal Research for inclusion in *Coal Abstracts*. *Coal Abstracts* is available to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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energyinfo ERA

Vol. 6, No. 7
ISSN: 0160-3604
CODEN: ERABDZ
April 15, 1981

ENERGY RESEARCH ABSTRACTS

ABOUT THE TECHNICAL INFORMATION CENTER

The Technical Information Center, as the national information center for the Department of Energy, manages, publishes, and disseminates scientific, technical, and practical energy information acquired from worldwide sources. It builds and maintains energy information data bases used to prepare abstracting journals, bibliographies, and literature searches. The data bases are also searchable via the Department's on-line retrieval system, DOE/RECON. This information is provided to DOE program offices and contractors; scientists; engineers; educational, commercial, and industrial communities; and the general public. The Technical Information Center conducts an active announcement and marketing program. It establishes policy and administers control of an inventory and registry for DOE publications. The Center also develops and evaluates new and effective information systems and services as required by scientific and technical management within the Department of Energy.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers, and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, conservation, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Federal, state, and municipal agencies concerned with energy development, conservation, and usage may obtain *ERA* free of charge. Inquiries should be directed to the Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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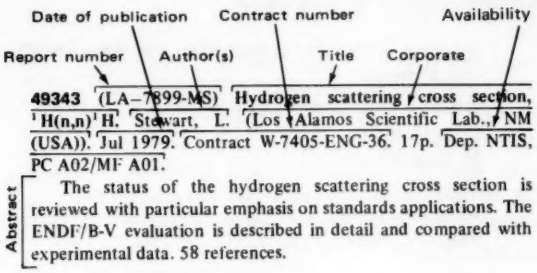
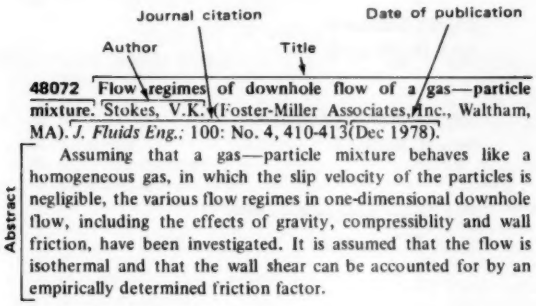
•ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Date of publication
Contract number
Availability
Report number
Author(s)
Title
Corporate
49343 (LA–7899-MS) Hydrogen scattering cross section, $^1H(n,n)^1H$. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.
Abstract
The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.


Journal citation
Date of publication
Author
Title
48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). J. Fluids Eng.: 100: No. 4, 410-413 (Dec 1978).
Abstract
Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

•INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. These indexes are cumulated semiannually and annually. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

•Corporate Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

49343 (LA–7899-MS) Hydrogen scattering cross section, $^1H(n,n)^1H$. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, $^1H(n,n)^1H$, 4:49343 (LA–7899-MS)

•Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Stewart, L., Hydrogen scattering cross section, $^1H(n,n)^1H$, 4:49343 (LA–7899-MS)
Stewart, M.D., *See* McInroy, J.F., 4:49280
Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

•Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles and informative phrases, or both, specific to these entries are arranged alphabetically under the entries.

HYDROGEN I TARGET
Neutron Reactions
Hydrogen scattering cross section, $^1H(n,n)^1H$ (Above 100 keV, review), 4:49343 (LA–7899-MS)
HYDROGEN NITRATES
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HYDROLOGY
Research Programs
Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, 96*th* Congress, 4:48749.

•Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	Los Alamos Scientific Lab., NM (USA)	
	3:49698	LA-tr–78-45
	3:49857	LA–7224T
	3:49863	LA–7235-MS
W-7405-ENG-48	California Univ., Livermore (USA). Lawrence Livermore Lab.	
	3:49386	UCRL–52456
	3:49431	UCRL–52405

•Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience.

LA-		
7899-MS	4:49343	Dep. NTIS, PC A02/MF A01
LA-tr-		
78-69	4:48158	Dep. NTIS, PC A03/MF A01

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SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 294 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope notes is available as DOE/TIC-4584-R4 from NTIS for $7.00.

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SUBJECT CONTENTS (ALPHABETICAL LISTING)

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8525 (CONF-800419—(Vol.2), pp 900-918) **Alternative fuels: SRC-II products and applications.** Freel, J. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The following topics are covered; a description of the SRC-II process; current economic projections for the SRC-II process; applications of the distillate fuel oil from the SRC-II process; co-product applications; and transportation applications.

8526 (DOE/ET/10104—T11) **Solvent refined coal (SRC) process: trace elements research & development report no. 53, interim report no. 34. Volume III. Pilot plant development work part 6: the fate of trace elements in the SRC process for the period, August 1, 1977 - February 28, 1979.** Filby, R.H.; Khalil, S.R.; Grimm, C.A.; Ekabaram, V.; Hunt, M.L. (Pittsburg and Midway Coal Mining Co., Englewood, CO (USA)). Dec 1980. Contract AC01-76ET10104. 169p. NTIS, PC A08/MF A01.

This work reports the results of neutron activation analysis determination of the fate of trace elements in the SRC II process. Six coals were studied for their behavior in material balance runs carried out at the Fort Lewis Pilot Plant. The distribution of trace elements among products and input streams was determined by thermal neutron activation analysis using thermal neutron flux of 8 x 10^{12} neutrons cm^{-2} sec^{-1} followed by Ge(Li) gamma ray spectroscopy. National Bureau of Standards Standard Reference Materials (SRM) were used to evaluate the analytical precision and accuracy of the methods used. For each material balance study the trace element input stream was taken as ground coal and the output streams were vacuum bottoms, SRC II product oil, and process water. In addition to these major components, oils, sludges and waters from liquid-liquid separators, effluent waters, biosludges, and by-product sulfur were also analyzed. Concerning the distribution of trace elements in the SRC II process, it was found that the vacuum bottoms was the major sink for all trace element studied, with the exception of Hg. Much lower trace element concentrations (except for Hg) were found in the SRC II product oil relative to the vacuum bottoms or the feed coal, irrespective of coal type. The results indicate excellent balances for the elements studied, except for Hg. Except for Hg, Se, and Cl, the SRC II product and process waters contributed less than 1% of the elemental balances for light oil fractions and process waters indicates that Hg, and to a lesser degree As, Se, and Sb, exhibited volatile behavior in the SRC II process but that the degree of volatility is strongly dependent on conditions or coal type.

8527 (DOE/ET/10328—27) **Coal hydrogasification process development. Quarterly technical progress report, October 1, 1980-December 31, 1980.** Combs, L.P.; Breese, L.S.; Kahn, D.R.; Schuman, M.D.; Adamson, C.W.; Lee, W.T. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Jan 1981. Contract AC01-78ET10328. 41p. NTIS, PC A03/MF A01.

A program schedule delineating the breakdown of the overall program into tasks and logical subtasks and time-phased relationships among them is shown in Figure 1. The major tasks are summarized below. Task I has been concerned with the engineering-scale testing. Testing was completed during June 1980 and data reduction and correlations have been continued since. This effort has provided key information to support decision/selection points concerning the Task II IPDU design and construction, as well as the Task III process design. Task II is concerned with the IPDU design, construction, and testing. Design of the facility was completed in May 1980; subsequently, attention has been devoted to letting construction subcontracts. IPDU construction recently has been rescheduled to occupy approximately the next 2 years, followed by approximately a year of testing. Task III provides for process optimization studies and for preliminary design of a commercial SNG plant, to be performed by an A-E subcontractor. The Lummus Company, a division of Combustion Engineering, is the subcontractor. Lummus will be supported by process and reactor operation analyses performed by Rockwell/ESG and Cities Service personnel and also will participate as a consultant in the direction of the long-duration experimental program.

8528 (DOE/ET/14503—3) **Development of a correlaton between slurry oil composition and process performance: analyses of slurry recycle oils from H-Coal PDU runs 5, 8 and 9. Final report.** Burke, F.P.; Winschel, R.A.; Pochapsky, T.C. (Conoco Coal Development Co., Library, PA (USA). Research Div.). Jan 1981. Contract AC05-79ET14503. 92p. NTIS, PC A05/MF A01.

Daily samples of slurry recycle oils from three thirty-day H-Coal PDU runs (5, 8 and 9) were analyzed by ^{1}H-NMR, GC/MS and various liquid chromatographic techniques. These data were interpreted in light of process performance to investigate the relationship between recycle oil composition and process performance. The data were also used to determine the approach of each PDU run to steady state operation. The results show that the composition of the non-distillate recycle components (resid) is much more sensitive to space velocity than the recycle distillate composition. At high space velocity the low recycle resid quality may be a significant factor, contributing to operability problems and rapid catalyst deactivation. Recycle composition depends more on space velocity than feed coal when comparing operations with Illinois 6 and Kentucky 11 coals. The recycle distillates in H-Coal operation are good hydrogen donors relative to, for example, SRC-I distillates. However, catalyst deactivation with respect to distillate composition appears to proceed at a slower pace than deactivation with respect to resid composition. This suggests that steady state performance may not have been achieved in these 30-day PDU runs, even though gross product distributions were at apparent steady state.

8529 (DOE/NASA/2593—20) **Deposition and material response from Mach 0.3 burner rig combustion of SRC-II fuels.** Santoro, G.J.; Kohl, F.J.; Stearns, C.A.; Fryburg, G.C.; Johnston, J.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1980. Contract AI01-77ET10350. 46p. (NASA-TM—81634). NTIS, PC A03/MF A01.

Collectors at 1173K (900°C) were exposed to the combustion products of a Mach 0.3 burner rig fueled with various SRC-II fuels (i.e., industrial turbine liquid fuels from solvent refined coals). Four fuels were employed - a naphtha, a light oil, a wash solvent and a mid:heavy distillate blend. The response of four superalloys (IN-100, U-700, IN-792, and Mar M-509) to exposure to the combustion gases from the SRC-II naphtha and resultant deposits was also determined. The SRC-II fuel analysis and insights obtained during the combustion experience are discussed. Particular problems encountered were fuel instability and reactions of the fuel with hardware components. The major metallic elements which contributed to the deposits were copper, iron, chromium, calcium, aluminum, nickel, silicon, titanium, zinc, and sodium. The deposits were found to be mainly metal oxides. An equilibrium thermodynamic analysis was employed to predict the chemical composition of the deposits. The agreement between the predicted and observed com-

pounds was excellent. No hot corrosion was observed. This was expected because the deposits contained very little sodium or potassium and consisted mainly of the unreactive oxides. However, the amounts of deposits formed indicated that fouling is a potential problem with the use of these fuels.

8530 **(DOE/NASA/10350—21) Catalytic combustion of coal-derived liquids.** Bulzan, D.L.; Tacina, R.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1981. Contract AI01-77ET10350. 26p. (NASA-TM—81594; CONF-810309—4). NTIS, PC A03/MF A01.

From ASME gas turbine conference; Houston, TX, USA (9 Mar 1981).

A noble metal catalytic reactor was tested with three grades of SRC II coal-derived liquids, naphtha, middle distillate, and a blend of three parts middle distillate to one part heavy distillate. A petroleum-derived No. 2 diesel fuel was also tested to provide a direct comparison. The catalytic reactor was tested at inlet temperatures from 600 to 800 K, reference velocities from 10 to 20 m/s, lean fuel-air ratios, and a pressure of 3 x 10^5 Pa. Compared to the diesel, the naphtha gave slightly better combustion efficiency, the middle distillate was almost identical, and the middle-heavy blend was slightly poorer. The coal-derived liquid fuels contained from 0.58 to 0.95% nitrogen by weight. Conversion of fuel nitrogen to NO/sub x/ was approximately 75% for all three grades of the coal-derived liquids.

8531 **(DOE/OR/03054—T2) SRC-1 Quarterly technical report, April-June 1980.** (International Coal Refining Co., Allentown, PA (USA)). 1980. Contract AC05-780R03054. 236p. NTIS, PC A11/MF A01.

The SRC-1 quarterly report has chapters on: an evaluation of current technologies for deashing coal liquids; domestic vendors of thick-wall pressure vessels; a comparative evaluation of GKT, Texaco and Shell-Koppers gasification processes (GKT is a modification of Koppers-Totzek and is recommended for reasons given); disposal or gasification of residues; evaluation of one or two slurry feed tanks; evaluation of one or two critical solvent deashing trains; analysis of causes of corrosion in the fractionating tower (chlorides and phenols); identifying and planning for pollution control in the demonstration plant; and characterizing waste center and monitoring its treatment. (LTN)

8532 **(DOE/PC/30088—3) Coal transformation chemistry third quarterly progress report.** Stock, L.M.; Blain, D.A.; Handy, C.I.; Huang, C.B.; King, H.H.; Landschulz, W.; Willis, R.S. (Chicago Univ., IL (USA)). 1980. Contract AC22-80PC30088. 22p. NTIS, PC A02/MF A01.

A Colorado subbituminous coal was reacted with potassium and naphthalene in tetrahydrofuran. This was then alkylated with n-butyl iodide and the solubility in tetrahydrofuran was determined. The solubility was found to be less than in a corresponding reaction with Illinois No. 6 coal. The solubilization of a Colorado subbituminous coal by reacting it with potassium in liquid ammonia, followed by alkylation is discussed. The preliminary results from a reaction of Illinois No. 6 coal with tetrabutylammonium hydroxide and methyl iodide are reported. Reductive acylation of coal is being studied at the present time using trifluoroacetic anhydride as a quenching reagent. ^{19}F is a candidate for nmr studies and chemical shifts for trifluoroacetyl derivatives of phenols, thiols, and amides indicate that fluorine may be useful as a sensitive probe for reactive species in coal. The effort on donor solvent coal chemistry was directed to the role played by pericyclic reactions in the liquefaction process. The acceptors were reduced by the deuterated donors. The isotopic distribution of the reduction product indicates that free radical processes occur preferentially. Thus, the pericyclic reactions appear to be unimportant at the threshold reaction temperatures of 350 to 425°C. The reactions of aromatic ethers with inorganic sulfide at 400°C produces thiophenols.

8533 **(DOE/TIC—11384) Solar coal gasification research (charge code D527) October 1 - December 31, 1980. Quarterly progress report.** Sullivan, J.A.; Jensen, R.J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 21p. NTIS, PC A02/MF A01.

The concept of solar coal gasification has been investigated in the laboratory using the beam from a CO_2 laser to simulate the radiation from a solar furnace. The parameters influencing the pyrolysis of stationary samples of Western subbituminous coal and the reaction of the char product with CO_2 to form CO were investigated, and many of the experimental conditions required for maximizing gas yields were determined. Tests of solar coal gasification were conducted using the small furnaces of NMSU and the 30-kw furnace at White Sands. The experiment and results are described. (MHR)

8534 **(FE—1743-70) Zinc halide hydrocracking process for distillate fuels from coal.** Belt, B.A.; Biasca, F.E. (Shell Development Co., Houston, TX (USA)). Nov 1979. Contract AC01-76ET10489. 76p. NTIS, PC A05/MF A01.

An economic evaluation has been completed of the Zinc Chloride Hydrocracking Process indicating that a 90-92 unleaded research octane number, 10.0 RVP gasoline can be produced from Western coal at a cost of about 76 cents/gallon at a 10% DCF rate-of-return, with equity financing and a 1979 economy. The process is described, and capital and operating costs are summarized.

8535 **(FE—1743-80(Vol.1)) Zinc halide hydrocracking process for distillate fuels from coal. Volume I. Summary and continuous bench studies. Final report, January 1975-November 1979.** Struck, R.T.; Zielke, C.W.; Pell, M.; Maskew, J.T.; Sim, F.; Rosenhoover, W.A.; Clark, W.E. (Conoco Coal Development Co., Library, PA (USA). Research Div.). 1 Dec 1980. Contract AC01-76ET10489. 298p. NTIS, PC A13/MF A01.

This report covers the development from 1975 through 1979 of the Conoco process for liquefaction of coal using a pool of molten zinc chloride as catalyst. Continuous bench-scale hydrocracking and regeneration units (1 kg/h) showed that both bituminous and subbituminous coals are operable and convert to high yields of gasoline and other distillates with unusually low nitrogen and sulfur contents. A data base and a rate model were developed for Rosebud Seam subbituminous coal allowing conversions and product distributions to be predicted as functions of temperature, pressure and residence time. Regeneration of the used catalyst was demonstrated giving 97+ % removal of C, N, O, S and ash. A secondary zinc recovery step was developed increasing the recovery to 99.7%. A 1 TPD Process Development Unit was designed and built. Solvent Refined Coal from Kentucky bituminous coal was run in the Hydro Section with recycle of all > 200°C distillates. Complete conversion to gasoline was indicated. Used catalyst from this was run through the Regeneration Section. Both sections confirmed yields, product qualities, and rates predicted for the 50:1 scaleup. Mechanical problems in the hydro compressors and catalyst circulating systems were largely solved by the end of the contract, but time did not permit integrated operation on coal. Materials of construction were largely satisfactory, but longer tests are needed for confirmation. Economic studies indicate that gasoline from Western subbituminous coal could be sold for 20 cents/litre (76 cents/gallon) from a 53,000 BPD plant, based on 1979 dollars and 10% DCF. This indicates that the process could be one of the most economic of all direct coal liquefaction processes.

8536 **(FE—1743-80(Vol.2)) Zinc halide hydrocracking process for distillate fuels from coal. Volume II. Tasks 4 through 10. Final report, January 1975-November 1979.** Struck, R.T.; Zielke, C.W.; Pell, M.; Maskew, J.T.; Sim, F.; Rosenhoover, W.A.; Clark, W.E. (Conoco Coal Development Co., Library, PA (USA). Research Div.). 1 Dec 1980. Contract AC01-76ET10489. 491p. NTIS, PC A21/MF A01.

8537 **(FE—1743-80(Vol.3)) Zinc halide hydrocracking process for distillate fuels from coal. Volume III. Appendices. Final report, January 1975-November 1979.** Struck, R.T.; Zielke, C.W.; Pell, M.; Maskew, J.T.; Sim, F.; Rosenhoover, W.A.; Clark, W.E. (Conoco Coal Development Co., Library, PA (USA). Research Div.). 1 Dec 1980. Contract AC01-76ET10489. 257p. NTIS, PC A12/MF A01.

8538 (FE—2566-43) Coal liquid/petroleum refinery integration. Gilder, G.A.; Burton, V.P. (UOP, Inc., Des Plaines, IL (USA)). 1980. Contract AC01-77ET10131. 23p. (CONF-8005115—1). NTIS, PC A02/MF A01.

From 45. midyear refining meeting; Houston, TX, USA (15 May 1980).

The United States' increasing dependency upon imported oil is alarming when viewed in the perspective that the availability of that oil is uncertain. Also, the escalating cost of that oil has given impetus to developing alternative energy sources. An area that has received considerable attention is the conversion of coal to liquid hydrocarbons suitable as substitutes for transportation fuels and heating fuels. This paper evaluates the economic feasibility of co-processing H-Coal liquid (derived from Hydrocarbon Research Inc.'s coal liquefaction process) and petroleum in a typical large refinery. Existing technology can be applied to co-process H-Coal liquid and petroleum; it is economically feasible when the value of the H-Coal liquid is about equivalent to the value of the imported crude oil. Because of the initial investment required to handle the H-Coal liquid, the processing economics are more favorable at 5% or 10% than at 3% H-Coal liquid concentration. Although this paper indicates the feasibility of co-processing H-Coal liquid with petroleum, additional work is being carried out to study: the compatibility of H-Coal liquids and petroleum; the cost of equipment modifications; and hydrotreatment of H-Coal liquids prior to processing in the existing refinery. This additional work has not been completed and the results could significantly affect the implication of this paper.

8539 (IS—4758) Alloy evaluation for fossil fuel process plants (liquefaction). Annual report, 1 October 1979-30 September 1980. Woods, C.M.; Scott, T.E. (Ames Lab., IA (USA)). Dec 1980. Contract W-7405-ENG-82. 77p. NTIS, PC A05/MF A01.

Objective is to evaluate the mechanical properties of liquefaction process plant dissolver vessel materials in a coal slurry-hydrogen environment. During this period, the following were studied: fatigue crack growth rates in 2-1/4Cr-1Mo steel; thermal expansion coefficients of A387, 316 SS, and 883 steels; tensile properties of 2-1/4Cr-1Mo steel after exposure to 4000 psig H_2 at 1000 or 950°F; corrosion of 2-1/4Cr-1Mo steel by coal slurry-H_2 at 800°F and 4000 psig; analysis of coal and coal oil; and phase stability diagrams of Fe, Cr, Mo, and Mn in H_2S-H_2-C-O. (DLC)

8540 (LA—8604-PR) Los Alamos National Laboratory Underground Coal Conversion supporting research program. Fiscal Year 1979 annual report. Kashiwa, B.A. (comp.). (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 30p. NTIS, PC A03/MF A01.

This report summarizes the results of activities in the Los Alamos National Laboratory Underground Coal Conversion supporting research program during fiscal year 1979. These activities included static and kinetic drying measurements on New Mexican subbituminous coal, ultimate analysis and gas permeability tests on the same coal type and a theoretical interpretation of subbituminous coal drying data. The relevance and significance of the results are discussed and recommendations for future work are made. Three appendices on similar subjects by different authors have been entered individually into EDB and ERA.

8541 (LA—8604-PR, pp 11-19) **Kinetic behavior of subbituminous coal drying; effects of confining pressure. Appendix B.** Brown, L.F. (Los Alamos Scientific Lab., NM); Kashiwa, B.A.; Vanderborgh, N.E.; Corlett, R.C. Dec 1980.

In Los Alamos National Laboratory Underground Coal Conversion supporting research program. Fiscal Year 1979 annual report.

A model is developed which explains drying behavior of a subbituminous coal. This model, a variation of the moving-boundary approach, has the vapor-liquid interface in the macropores receding from the exterior surface of the coal as drying progresses. On the liquid side of the interface, liquid water exists in all three pore systems - macropores, transitional pores, and micropores. On the vapor side of the interface, in the transitional and micropore systems branching off the macropores, the moisture essentially is in equilibrium with the water vapor in the macropore system. Water diffuses from the liquid interface in the macropores through these pores to the exterior surface of the coal. Experiments with a Washington State subbituminous coal are described which test this model. The predictions of the model match the behavior of experimental drying curves. The effective diffusivities obtained were within the range expected for the constricted pore systems which coal possesses. Higher initial stresses apparently decrease the total porosity and increase the severity of pore constrictions. Disparities between model prediction and experimental behavior, which occurred at a late drying time, result from the assumed water adsorption isotherm.

8542 (LBL—11341(Rev.)) Platelet mechanism of erosion of ductile metals. Bellman, R. Jr.; Levy, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1980. Contract W-7405-ENG-48. 15p. (CONF-810301—1(Rev.)). NTIS, PC A02/MF A01.

From International conference on wear of materials; San Francisco, CA, USA (31 Mar 1981).

The removal of material from the surface of a ductile metal by small impacting particles is a design concern to the builders of synthetic fuels plants that utilize pulverized coal to produce gaseous forms of fuel. A series of room temperature experiments was conducted to determine the mechanism of material removal when an erosive particle stream impacts on a ductile metal surface. 1100-0 and 7075-T6 aluminum were used for the target and 600 μm SiC particles moving at a velocity of 100 fps in air for the eroding stream. It was determined that a combined forging-extrusion mechanism that produces small, highly distressed platelets of target material that are knocked off the surface by succeeding particle impacts is responsible for erosion at both low and high impingement angles. The proposed mechanism is a significant departure from the previously believed micro-machining mechanism of erosion of ductile metals.

8543 (MIT—2295T9-16) Computer-aided industrial process design. The ASPEN project. Fourth annual report for the period, June 1, 1979 to May 31, 1980. (Massachusetts Inst. of Tech., Cambridge (USA)). 15 Jun 1980. Contract AT01-76ET10696. 146p. NTIS, PC A07/MF A01.

The ASPEN system has been implemented and tested quite extensively during the past year. Although ASPEN runs well now for many types of problems, users continue to uncover errors and to find problems that need to be corrected. This is expected in any large software system such as ASPEN. Benchmark testing of ASPEN has been completed. Process and economic simulations were completed of the coal liquefaction/solvent hydrogenation sections of the Exxon Donor Solvent Process. Also, a process simulation of a petroleum hydrodesulfurization process was completed. A preliminary User's Manual of about 1000 pages has been prepared and has been revised three times. Training materials have been developed for an introductory four-day user course. Four courses have been held and 104 users have attended. A number of enhancements, determined to be of high priority for ASPEN users, have been developed and implemented. Discussions and plans have been started to transfer ASPEN technology and deliver the ASPEN computer code to a number of DOE sites. Two sites most interested are Morgantown (METC) and Oak Ridge (ORNL). Others include Laramie (LETC) and Grand Forks (GFETC).

8544 (ORNL/TM—7428) Environmetrics of synfuels. I Processing the automated PDP-11 data components for the UMD gasifier facility. Strand, R.H.; Farrell, M.P.; Gudmundson, C.W.; Birchfield, T.K.; Casada, S.S.; Vansuch, M.E. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 40p. NTIS, PC A03/MF A01.

This report summarizes the techniques and procedures used to handle automated data collected at the University of Minnesota-Duluth (UMD) campus coal gasification facility. This facility, which is partially funded by the Department of Energy, is being evaluated by scientists at Oak Ridge National Laboratory (ORNL) for its potential health and environmental effects. Automatic data collections and manually collected and sample results data are used for this assessment. A data management project at ORNL handles these and other UMD data for the Gasifiers in Industry Program (GIIP). Specifically, this report documents the procedures devel-

oped within the data management project for handling two categories of automated data: (1) process and (2) environmental. The examples included use actual data from the first one and a half years of gasifier operation.

8545 **(UCRL—53052) Underground coal gasification site selection and characterization in Washington State and gasification test designs.** Stone, R.; Hill, R.W. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 10 Sep 1980. Contract W-7405-ENG-48. 61p. NTIS, PC A04/MF A01.

A program of investigation has been carried out to identify and characterize a site in Washington state suitable for underground coal gasification (UCG) experiments and possible commercial development. A site in the Tono Basin of the Centralia-Chehalis district containing an estimated 5 x 10^{10} kg of subbituminous coal in two deeply buried seams (the Lower Thompson and the Big Dirty) was found that may be suitable for underground coal gasification (UCG) experiments and possible commercial development. Eight exploratory boreholes and two test wells were drilled to provide the primary subsurface geologic and hydrologic information about the site. A series of surface gasification tests using large blocks of coal cut free of the Big Dirty seam in mine exposures will be conducted to establish a preliminary set of in situ operational parameters-air injection pressures, flow rates, and coal consumption rates. If the site is found suitable, the surface gasification tests will be followed by two deep underground gasification experiments - one employing borehole linking and the other reverse combustion-linking. The proposed large coal block surface gasification tests and the UCG experiments will provide a basis for decisions concerning the nature of future gasification efforts in the Tono Basin.

8546 **Separation of solids from coal liquefaction products via countercurrent solvent deasphalting.** Quarderer, G.J.; Moll, N.G. (Dow Chemical Co., Midland, MI). *Separation Science and Technology (U.S.);* **15**: No. 3, 165-183(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

Counter-current deasphalting is a key unit operation in the Dow Liquefaction Process. The Dow developed deasphalter removes typically 99.8 to 99.9% of the ash and 94 to 95% of the toulene insoluble hydrocarbons from the coal liquefaction product. The deasphalted oil, after separation from solvent, contains less than 0.05% ash. Deasphalted coal liquefaction product, a low sulfur, low residue, premium synthetic oil, constitutes 40% of the net liquefaction products. The deasphalter residue typically contains 40% ash and up to 25% hydrocarbonaceous coal solids. It has a heating value of approximately 9000 Btu/lb and is produced as a viscous pumpable fluid. The properties are important in the Dow Process where deasphalter residue is gasified to generate the hydrogen for the liquefaction step. The solvent used in the deasphalter is a paraffinic 50 to 75°C light oil cut from the liquefaction unit. The counter-current deasphalting technology is based on the results from model and batch studies and results from the operation of two different 23 kg/hr continuous deasphalters. Operational parameters which have been studied include: extraction temperature and pressure, solvent to oil ratio, feedrate, coal oil composition and variations in column design. The mass transfer which occurs during the deasphalting of coal liquefaction product is accompanied by interfacial tension gradients which develop naturally during the extraction process. The resulting interfacial convection (referred to as a Marangoni instability) profoundly enhances the rate of the extraction process and greatly simplifies the design of the extraction column.

8547 **Effect of oil types and additives on the separation by flotation of unconverted coal and mineral matter from liquefaction products.** Saad, E.T. (Ashland Oil, Inc., KY); Bhattacharyya, D.; Kermode, R.I. *Separation Science and Technology (U.S.);* **15**: No. 3, 185-200(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

The flotation behavior of various solids (H-coal vacuum bottoms, SRC solids, and pure clays) of different sizes dispersed in light cycle oil (LCO) or H-coal or clarified solvent refined coal oil (SRC) is studied with CO_2 bubbles under semi-batch operation after precooking (at 100°C to 120°C) the solids in oils for 30 minutes. In all cases maximum flotation efficiency is achieved with a bulk liquid temperature of 110°C, and a 30 to 40°C temperature gradient between the liquid and the upper foam layer. The flotation of particles is best with LCO containing 6% cresol as additive. The separation is negligible with SRC oil because of high viscosity. With H-coal solids dispersed in LCO (+ 6% cresol) the separation is 85% with 100 μm particles and only 10% with 10 to 15 μm particles. By the addition of an agglomerating solvent (5% to 10% decane) the separation of 10 μm particles is increased to 45%. With respect to the separation of pure clays and minerals (dispersed in LCO) the separation of wollastonite (70% with 100 μm particles) is better than that of illite (35% with 100 μm particles). The flotation of kaolinite is always found to be insignificant.

8548 **Precoat filtration of coal liquid feasibility study of bottom ash precoat.** Shou, J.K.; Collins, D.J.; Do, D.M.; Scharff, R.P. (Univ. of Kentucky, Lexington). *Separation Science and Technology (U.S.);* **15**: No. 3, 201-221(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

In this work, the suitability of using coal bottom ash as a precoat material for pressure filtration of liquefied coal was studied experimentally. Filtration of SRC I filter feed was accomplished in a laboratory filtration unit (1.5 in^2) using both coal bottom ashes and a commercial diatomaceous filter aid (celite 550). Filtration experiments were carried out at temperatures ranging from 150°C to 200°C, and pressure differential ranging from 35 psid to 100 psid. Both materials were comparable in terms of the resistance of the cake and precoat media to filtration. Also both gave filtrates with less than 0.1% ash and 0.7 % sulfur, thus meeting EPA combustion emission standards.

8549 **Filtration of slurries from coal liquefaction processes.** Briggs, D.E.; Cameron, J.R.; Ho, B.; Islip, P.N.; McKeen, J.A. (Univ. of Michigan, Ann Arbor). Contract EX-76-5-01-2550. *Separation Science and Technology (U.S.);* **15**: No. 3, 223-248(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

Coal liquefaction slurries are more complex than most filtration slurries. They contain a wide spectrum of materials which range from small individual molecules to very large mineral solids and agglomerated solids. The mean effective particle size of the solids in the cake and the viscosity are both significantly affected by the presence of preasphaltenes and asphaltenes with multiheteroatoms. Selective addition of association/agglomeration-inducing solvents can dramatically increase the filtrate flow rate by decreasing both the viscosity and specific cake resistance. These decreases more than compensate for the need to process slightly more slurry with a slightly increased amount of cake. In coal liquefaction processes, the solids separation process must be considered in terms of the total process material and energy balances and the total plant capital cost. By selectively removing those fractions which tend to peptize colloidal particles and adding back fractions which promote association, filtration rates can be improved while simultaneously reducing the levels of multiheteroatom species which cause cake deposits on catalysts during subsequent product up-grading.

8550 **Evaluation of hydroclone operation for the removal of micron-sized particles from viscous liquids.** Talbot, J.B. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Separation Science and Technology (U.S.);* **15**: No. 3, 277-296(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

The performance of a 1-cm-diam, Dorr-Oliver hydroclone with slurries containing about 5 wt % solids in water-glycerin solutions was studied to evaluate the effects of fluid viscosity. Micron-sized particles of low-density solids (kaolin) were removed from solutions with viscosities ranging from 1 to 13 cP. Pressure drop across the hydroclone increased with increasing feed rate and viscosity. Gross and centrifugal efficiencies were found to increase with flow rate and decrease with viscosity. The particle diameter, corresponding to a point efficiency of 50%, decreased as the inlet Reynolds number increased.

8551 **Open-pore polyurethane as a medium for coal conversion process aqueous effluent cleanup.** Denton, M.S. (Oak Ridge National Lab., TN); Dinsmore, S.R.; Brand, J.I.; Beams, J.; Ball, F.L. Contract W-7405-ENG-26. *Separation Science and Technology (U.S.);* **15**: No. 3, 587-613(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

A study was made of varying the reaction conditions of in-situ polymerized open-pore polyurethane (OPP). Optimum conditions were determined by electron microscopy and flow-rate studies. Using these conditions, large 1-in x 12-in columns were polymerized and compared, by use of a four-column bench-scale adsorption apparatus, with the same type columns filled with three common commercial adsorbents. Breakthrough curves (TOC, total phenol, etc.) of a synthetic and an actual coal conversion wastewater were then plotted for each of these columns.

8552 **IGT U-GAS Gas Process: demonstration plant program.** Rehmat, A.; Thakkar, P. Chicago, IL; Institute of Gas Technology (1980). 16p. (CONF-801142—4).

From 3. international coal utilization exhibition and conference; Houston, TX, USA (18 Nov 1980).

The Memphis Light, Gas and Water Division of the City of Memphis and the Department of Energy have entered into a contract to design, construct, and operate the Industrial Fuel Gas Demonstration Plant. The plant is based upon the U-GAS Gas Process developed by the Institute of Gas Technology for converting coal to a medium-Btu (300 +- 30 Btu/SCF) fuel gas, and is to demonstrate the technical, economic, and environmental performance of the process. The demonstration plant will incorporate full-scale U-GAS gasifiers using the data base developed at the U-GAS Pilot Plant. It will process about 3158 tons per day of Western Kentucky No. 9 coal, producing approximately 154 million SCF per day of fuel gas. The gas will be distributed to industrial customers through a dedicated pipeline system.

0106 Properties

8553 **(CONF-801226—3) Use of model compounds in coal chemistry.** Collins, C.J. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 25p. NTIS, PC A02/MF A01.

From American Chemical Society southeast-southwest regional meeting; New Orleans, LA, USA (10 Dec 1980).

The use of model compounds in coal chemistry has been summarized. Several examples from the literature, and also from work at Oak Ridge National Laboratory have been used to illustrate the main principles involved. The current controversy on the subject of model compounds is believed to stem from a semantic misunderstanding owing to different definitions of what a model compound is. The definition of a model compound from the organic chemist's point of view is that it is a substance which may possess at least one property or structural feature suspected of being present in the sample investigated. The sample may be coal itself, a maceral, a coal-derived material or a hydrogen-donor solvent. It is stressed that a recognition of the structure-reactivity relationship in organic compounds is necessary to avoid false conclusions.

8554 (DOE/ET/10816—T2, pp 5-8) **Characterization of coal for open cycle MHD power generation system.** Diebold, F. 1980.

In MHD power generation research, development and engineering. Quarterly progress report, January to March 1980.

The work to establish an integrated set of procedures for the rapid analysis of coal samples has been nearly completed. The automated combustion train technique for simultaneous analysis of C, H, and N in the coal samples has been re-established and shown to be comparable in accuracy and precision but superior in efficiency to the ASTM techniques. Elimination of the contamination in the ion chromatographic analysis of F, Cl, S, and P has moved this technique much closer to being established. The addition of appropriate accessories, the availability of new software for the ICPES, and the near completion of the sample preparation work means that the rapid, accurate, and precise analysis of a large number of metals in coal is a reality. The acquisition of additional Rosebud tipple samples and the continuing preparation and analysis of these samples will result in the completion of this task by the end of this contract period.

8555 **(FE—2031-17) Chemistry and structure of coal derived asphaltenes and preasphaltenes. Quarterly progress report, April-June 1980.** Yen, T.F. (University of Southern California, Los Angeles (USA)). 1980. Contract AC01-76ET10626. 97p. NTIS, PC A05/MF A01.

It is the objective of this project to isolate the asphaltene and preasphaltene fractions from coal liquids from a number of liquefaction processes. These processes consist of in general: catalytic hydrogenation, staged pyrolysis and solvent refining. These asphaltene fractions may be further separated by both gradient elution through column chromatography, and molecular size distribution through gel permeation chromatography. Those coal-derived asphaltene and preasphaltene fractions will be investigated by various chemical and physical methods for characterization of their structures. After the parameters are obtained, these parameters will be correlated with the refining and conversion variables which control a given type of liquefaction process. The effects of asphaltene in catalysis, ash or metal removal, desulfurization and denitrification will also be correlated. It is anticipated that understanding the role of asphaltenes in liquefaction processes will enable engineers to both improve existing processes, and to make recommendations for operational changes in planned liquefaction units in the United States. The objective of Phase 1 was to complete the isolation and separation of coal liquid fractions and to initiate their characterization. The objective of Phase 2 is to continue the characterization of coal asphaltenes and other coal liquid fractions by use of physical and instrumental methods. The structural parameters obtained will be used to postulate hypothetical average structures for coal liquid fractions. The objective of Phase 3 is to concentrate on the characterization of the preasphaltene (benzene insoluble fraction) of coal liquid fraction by the available physical and chemical methods to obtain a number of structural parameters.

8556 (LA—8604-PR, pp 20-27) **Permeability measurements and ultimate analysis of San Juan subbituminous coal. Appendix C.** Hermes, R.E.; Trujillo, P.E. Dec 1980.

In Los Alamos National Laboratory Underground Coal Conversion supporting research program. Fiscal Year 1979 annual report.

Core samples including overburden, coal seam and underburden, from a potential UCC site in northwestern New Mexico, have been tested for gas permeability and ultimate analysis. A method is described for the preparation of fragile core samples for use in a dual differential permeability apparatus. A compressible elastomeric sleeve was used as a sample holder for permeability measurements using a pressure drop of one atmosphere of nitrogen gas across the sample. The range in permeabilities was from 1.6×10^{-7} to 3.7×10^{-2} darcy. Results of elemental analysis on similar core samples are given at various elevations in the coal seam.

8557 **(UCRL—85101) High rate spectroscopy for on-line nuclear coal analyzer (Nucoalyzer).** McQuaid, J.H.; Brown, D.R.; Gozani, T.; Bozorgmanesh, H. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 1980. Contract W-7405-ENG-48. 8p. (CONF-801103—43). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

A high count rate, time-variant Ge(Li) spectrometer has been developed for on-line coal analysis. The analyzer is being fabricated for use in a power generating station. Prompt neutron activation of coal samples is the basis of analysis, with ^{252}Cf as the source for irradiation. The spectroscopy system allows counting rates up to 150 k counts per second without significant loss in energy resolution or peak shape. The high data throughput allows the coal analyzer to be used for on-line process control. The coal analyzer will be discussed, with emphasis on the high-rate signal processing system. Results of analysis of coal samples will be presented.

0108 Waste Management

REFER ALSO TO CITATION(S) 9121, 9124, 9125, 9126, 9671

8558 **(ANL/EES-TM—118) Problems associated with solid wastes from energy systems.** Chiu, S.Y.; Fradkin, L.; Barisas, S.; Surles, T.; Morris, S.; Crowther, A.; DeCarlo, V. (Argonne National Lab., IL (USA)). Sep 1980. Contract W-31-109-ENG-38. 177p. NTIS, PC A09/MF A01.

Waste streams from many energy-related technologies including coal, oil shale, tar sands, geothermal, oil and gas extraction, and nuclear power generation are reviewed with an emphasis on waste streams from coal and oil shale technologies. This study has two objectives. The first objective is to outline the available information on energy-related solid wastes. Data on chemical composition and hazardous biological characteristics are included, supplemented by regulatory reviews and data on legally designated hazardous waste streams. The second objective is to provide disposal and utilization options. Solid waste disposal and recovery requirements specified under the RCRA are emphasized. Information presented herein should be useful for policy, environmental control, and research and development decision making regarding solid and hazardous wastes from energy production.

8559 **(DOE/ET/20023—5) Solid waste management of coal conversion residuals from a commercial-size facility: environmental engineering aspects. Final report.** Bern, J.; Neufeld, R.D.; Shapiro, M.A. (Pittsburgh Univ., PA (USA)). 30 Nov 1980. Contract AC22-79PC20023. 330p. NTIS, PC A15/MF A01.

Major residuals generated by the conversion process and its auxiliary operations include: (a) coal preparation wastes; (b) gasifier ash; (c) liquefaction solids-char; (d) tail gas or flue gas desulfurization sludge; (e) boiler flyash and bottom ash; (f) raw water treatment sludge, and; (g) biosludges from process wastewater treatment. Recovered sulfur may also require disposal management. Potential environmental and health impacts from each of the residues are described on the basis of characterization of the waste in the perspective of water quality degradation. Coal gasification and liquefaction systems are described in great detail with respect to their associated residuals. Management options are listed with the conclusion that land disposal of the major residual streams is the only viable choice. On-site versus off-site disposal is analyzed with the selection of on-site operations to reduce political, social and institutional pressures, and to optimize the costs of the system. Mechanisms for prevention of leachate generation are described, and various disposal site designs are outlined. It is concluded that co-disposal feasibility of some waste streams must be established in order to make the most preferred solid waste management system feasible. Capacity requirements for the disposal operation were calculated for a 50,000 bbl/day coal liquefaction plant or 250 million SCF/day gasification operation.

8560 **Redistribution of accessory elements in mining and mineral processing. Part I. Coal and oil shale.** Washington, DC; National Academy of Sciences (1979). 188p.

The Committee on Accessory Elements was established to investigate the redistribution of accessory elements and compounds in future large-scale mining and processing of selected mineral materials. The principal objectives of the study are to examine potentially harmful consequences of element redistribution on the environment and to assess the opportunities for economic byproduct recovery of accessory elements. Attention is focused on mining and processing methods because of the important role of technology in the redistribution and recovery of accessory elements and compounds. The study also points out research needed for improving our understanding of environmental consequences and byproduct potential of large-scale mining activities. A principal reason for the study is the expectation that major increases in domestic production of many mineral commodities will occur, either as a result of changing national policies or actions abroad, which may result in significant impacts on the environment as well as on the potential for important byproduct recovery. The Committee does not address health problems that might result from the redistribution of accessory elements, but it does discuss redistribution pathways through which toxic elements may reach the environment, thus providing an alert to potential health hazards.

0109 Environmental Aspects

8561 **(DOE/ET/10104—T12) Remedial measures plan for a spill of solvent refined coal liquid at the SRC Pilot Plant, Ft. Lewis, Washington. Final report.** Grimshaw, T.W.; Little, W.M. (Radian Corp., Austin, TX (USA)). 22 Aug 1980. Contract AC01-76ET10104. 215p. NTIS, PC A10/MF A01.

On 19 December 1979, a spill of SRC liquid occurred during transfer of the liquid from a storage tank to sample drums. Approximately 2300 gallons of fluid flowed into the floor of the tank farm and infiltrated into the porous and permeable gravels at the site. Because of concern for the possible impact of the SRC fluid on the quality of ground water, surface water, and water supply sources at and near the site, GMRC commissioned Radian to evaluate the problem and recommend specific measures to mitigate any known or anticipated impacts. This report presents the results of Radian's investigations. Although ground-water contamination apparently has occurred as a result of the 19 December spill, the contamination plume is localized to the vicinity of the SRC plant and Lake Sequalitchew. A contamination plume apparently is presently moving toward Lake Sequalitchew, but the two pump wells included in the Remedial Mesures Plan will arrest this movement. These wells will be pumped until phenol concentrations in the groundwater fall to acceptable levels. The source of contamination at the spill is being cut off by excavation of the contaminated soil and sealing of the floor of the tank farm. No public water supplies are appreciably endangered by the 19 December spill. Most public wells are upgradient from the spill and are thus in no danger. The downgradient wells are protected by the fact that they tap deeper aquifers than the upper aquifer at the SRC plant site and by the buffering effect of Lake Sequalitchew. The upper aquifer in the vicinity of the spill site probably should not be considered for use as a public or private water supply for the foreseeable future.

8562 (DOE/EV—0128, pp 5-59) **Coal.** Jun 1980.

In Division of Environmental Control Technology Program, 1979.

This section evaluates the environmental impacts of alternative systems for generating electricity from coal. In 34 separate reports, information on controlling sulfur dioxide, respirable particulates, hazardous hydrocarbons and radioactive emissions is presented along with an evaluation of the management of wastes such as the disposal of flue gas desulfurization sludges. Various aspects of the coal conversion process are discussed including effluent control, wastewater treatment and the evaluation of pollutants from flash hydropyrolysis. Some characteristics of coal materials transportation systems are included. (KRM)

8563 **(FES—81-4) Final environmental impact statement for a proposed strip coal mine on Ute Mountain Ute Tribal lands, San Juan County, New Mexico.** (Bureau of Indian Affairs, Albuquerque, NM (USA)). 1981. 113p. NTIS.

The proposed action is the approval by the Department of the Interior of a lease of Ute Mountain Ute Tribal lands for the purpose of mining coal. The lease area is entirely located on the Ute Mountain Ute Reservation, San Juan County, in northwestern New Mexico. The proposed project will consist of a 10-year lease with an option to renew for 10 years. Exploration conducted in the late 1960's has indicated approximately 8 to 10 million tons of coal that can be strip-mined. Environmental impacts have been presented. Disturbance will occur to topography, soils, flora, fauna, air quality, surface and groundwater hydrology, plus cultural resources. Additional impacts will occur through noise and visual effects and socio-economic impacts. Alternatives considered include: nondevelopment of project and alternative mining methods.

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 8580

8564 (NCEI—0025) Peat resources of North Carolina. Annual report, 1980. Otte, L.J.; Ingram, R.L. (North Carolina Univ., Chapel Hill (USA). Dept. of Geology). Nov 1980. Contract AC01-79ET14693. 64p. NTIS, PC A04/MF A01.

Peat deposits of North Carolina are of three main geologic types representing the accumulation of organic matter in: (1) pocosins (broad shallow depressions on an uplifted sea floor), (2) river flood-plains, and (3) Carolina Bays (elliptical depressions of unknown origin). The largest pocosin deposits are: (1) Pamlimarle Peninsula (360 square miles, 210 million tons moisture-free peat), (2) Dismal Swamp (100 square miles, 60 million tons), and (3) Croatan Forest (40 square miles, 23 million tons). These deposits normally range in thickness from 1 to 8 feet. River flood plain peats are of unknown extent. They occur as lenses in alluvial sands and clays and may attain a thickness of 20 feet. The ash content usually exceeds 10%. Five to six hundred Carolina Bays from 0.2 to 3 miles in length are scattered over the Coastal Plain. Many contain high quality peats up to 15 feet thick. Most North Carolina peat is a black fine-grained, highly decomposed peat with ash contents commonly less than 5%. Sulfur contents are low (median 0.2%), and heating values are high (median 10,300 Btu/lb moisture-free). North Carolina has an estimated 1000 square miles (640,000 acres) of peatland containing about 600 million tons of moisture-free peat.

0120 Mining

8565 (DOE/MC/08089—T21) Methane recovery from coalbeds project. Monthly progress report. (TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.). Nov 1980. Contract AC21-78MC08089. 144p. NTIS, PC A07/MF A01.

Progress made on the Methane Recovery from Coalbeds Project (MRCP) is reported in the Raton Mesa Coal Region. The Uinta and Warrior basin reports have been reviewed and will be published and delivered in early December. A cooperative core test with R and P Coal Company on a well in Indiana County, Pennsylvania, was negotiated. In a cooperative effort with the USGS Coal Branch on three wells in the Wind River Basin, desorption of coal samples showed little or no gas. Completed field testing at the Dugan Petroleum well in the San Juan Basin. Coal samples showed minimal gas. Initial desorption of coal samples suggests that at least a moderate amount of gas was obtained from the Coors well test in the Piceance Basin. Field work for the Piceance Basin Detailed Site Investigation was completed. In the Occidental Research Corporation (ORC) project, a higher capacity vacuum pump to increase CH_4 venting operations has been installed. Drilling of Oxy No. 12 experienced delays caused by mine gas-offs and was eventually terminated at 460 ft after an attempt to drill through a roll which produced a severe dog leg and severely damaged the drill pipe. ORC moved the second drill rig and equipment to a new location in the same panel as Oxy No. 12 and set the stand pipe for Oxy No. 13. Drill rig No. 1 has been moved east of the longwall mining area in anticipation of drilling cross-panel on 500 foot intervals. Waynesburg College project, Equitable Gas Company has received the contract from Waynesburg College and has applied to the Pennsylvania Public Utilities Commission for a new tariff rate. Waynesburg College has identified a contractor to make the piping connections to the gas line after Equitable establishes their meter and valve requirements.

8566 (DOE/TIC—11383) Push-pull test: a method of evaluating formation adsorption parameters for predicting the environmental effects on in situ coal gasification and uranium recovery. Drever, J.I.; McKee, C.R. (Wyoming Univ., Laramie (USA). Dept. of Geology; Insitu Consulting, Laramie, WY (USA)). Nov 1980. 30p. NTIS, PC A03/MF A01.

The push-pull test, which is a simple injection and pumping sequence of groundwater spiked with solutes of interest, is presented as a method of determining the adsorption characteristics of a formation. Adsorption properties are necessary to predict restoration from both in situ coal gasification and in situ uranium extraction. The major problems in applying laboratory measurements to the field concern scaling the effect of particle size and obtaining representative samples. Laboratory measurements are conducted on gram to kilogram scale samples, whereas the push-pull test evaluates a sample weighing approximately 130 to 1000 metric tons, depending on volume injected and porosity. The problem in translating laboratory results to the field appear to be less severe for sedimentary uranium bodies than for coal. Laboratory measurements are useful in delineating ranges in adsorption properties and in planning the field experiment. Two field push-pull tests were conducted on uranium formations in Wyoming. Adsorption properties estimated from these tests on the basis of a simple cell model were compared to the laboratory values. In the first case, excellent agreement was observed between the values estimated from the field test and the values measured in the laboratory. In the second case, the value for K/sub d/ determined in the laboratory was five times higher than the field value. It is recommended that push-pull tests be conducted on coal formations being considered for in situ gasification in view of the great uncertainty in extrapolating laboratory adsorption properties to the field.

8567 (FE—9120-T1) Underspoil haulage of surface mined coal. Final technical report. (Dravo Corp., Denver, CO (USA)). 1 Feb 1980. Contract ET-76-C-01-9120. 286p. NTIS, PC A13/MF A01.

Underspoil haulage is defined as the transport of coal from the pit bottom by conveyor through a tunnel maintained under the spoil piles. The main objective in promoting this study was to test, through engineering and economic analysis, the feasibility of constructing and operating this belt conveyor underspoil haulage system. Other continuous coal transporting concepts were also to be proposed to supplement underspoil haulage systems and to provide technical and economic comparisons to underspoil systems. Four underspoil haulage systems for underspoil haulage of coal from a model strip mine were investigated and compared to more conventional truck haulage. Underspoil haulage showed itself to be economically favorable for coal thicknesses greater than 40 feet buried under 100 feet or more of overburden and mined at five million tons or more per year. Secondary studies showed that several other continuous haulage methods are potential as alternatives to underspoil haulage or may be operable under criteria that are impractical for underspoil.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 8541, 8567, 9234, 9235, 9245

8568 (LA—8604-PR, pp 5-10) Kinetic and equilibrium measurements of coal drying. Appendix A. Heller, A.; Elliott, G.R.B. (Los Alamos National Lab., NM). Dec 1980.

In Los Alamos National Laboratory Underground Coal Conversion supporting research program. Fiscal Year 1979 annual report.

The retention, attachment, and release of water (sorption, adsorption, and desorption) in Fruitland subbituminous coal are shown to be very complex phenomena. The vapor pressure and thermodynamic activity of water in the coal at about 315°K vary sharply with water content. Removal of 60% of the water initially present reduces the vapor pressure by about 60%. The total moisture content of saturated coal also varies with temperature. A 10°K rise in temperature reduces the sorbed water by about 8%. There is strong hysteresis in the sorption behavior; water which is desorbed by reducing the vapor pressure over a coal sample is not fully replaced by adsorption when the vapor pressure is returned to its original level. These measurements of desorption and adsorption reflect stable and metastable equilibria. Kinetic measurements are reported for approach to a new equilibrium if the vapor pressure over the coal is reduced. The kinetic measurements reflect the shape of the pores while equilibrium vapor pressures reflect how tightly the water is bound in the pores. Both types of measurement show changes in behavior at the same compositions. Implications of these results for UCC are discussed.

8569 **Density separation of solids in ferrofluids with magnetic grids.** Fay, H. (Union Carbide Corp., Tonawanda, NY); Quets, J.M. *Separation Science and Technology (U.S.);* **15**: No. 3, 339-369(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

Nonmagnetic solids in a superparamagnetic ferrofluid are subjected to body forces proportional to the intensity of magnetization of the fluid and the gradient of the magnetic field. An apparent density of the fluid can be defined from the force equations, and since the apparent density can be much larger than the true density, it is possible to levitate or float dense objects. Mixtures of solids with a density greater than the apparent density sink while lower density solids float. In practice it is difficult to create a uniform gradient over a large volume and single gap magnetic separators require very large magnets or have a limited throughput. To overcome that problem, multiple gap magnetic grids have been designed. Such grids consist of planar arrays of parallel bars of alternating polarity, driven by permanent magnets. When immersed in ferrofluid, magnetic grids create nonuniform field gradients and apparent densities in the fluid. However, both analysis and experimental measurements show that the grid acts as a barrier to particles below a critical density, while permitting more dense particles to fall through the grid. Thus, a magnetic grid filter can be used as a high throughput binary separator of solids according to their densities. Such filters can be cascaded for more complex separations. Several magnetic grid filters have been designed, built, and tested. Magnetic measurements qualitatively agree with the theoretical predictions. Experiments with synthetic mixtures have demonstrated that good binary separations can be made.

8570 **Field-flow fractionation: potential role in the analysis of energy related materials.** Giddings, J.C.; Graff, K.A.; Myers, M.N.; Caldwell, K.D. (Univ. of Utah, Salt Lake City). Contract AC02-79EV-10244-A000. *Separation Science and Technology (U.S.);* **15**: No. 3, 615-635(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

The general principles and scope of field-flow fractionation (FFF) are presented with descriptions of individual FFF subtechniques and the macromolecular, colloidal, and fine particle systems to which they have been applied. Several specific examples of energy-related materials are presented for which FFF is expected to yield important analytical information.

8571 **Plant coal inventory and storage procedures: economic and environmental considerations.** Darling, J.P. Chattanooga, TN; Tennessee Valley Authority (1980). 14p. (CONF-800264—2). Library, American Public Power Association, Washington, DC $3.00.

From 24. American Public Power Association annual engineering and operations workshop; Phoenix, AZ, USA (25 Feb 1980).

Coal presently plays a primary role in TVA's generation of electricity, and we anticipate that it will continue to do so into the Twenty-First Century. We recognize that coal can create environmental problems if not properly handled; however, we believe these potential problems can be dealt with whether they be in the mining, transporting, handling, or burning of coal. Uncontrolled coal dust can contribute to a dirty environment, but TVA has been quite successful in allaying coal dust at our power facilities. This has been accomplished through the use of wet suppression, enclosed conveyor systems, dust collection equipment at transfer point, and coal storage silos. The particulates from the plants are being controlled by large electrostatic precipitators, baghouse collectors, or venturi scrubbers. SO_2 emissions are being controlled by use of lower sulfur coals, coal washing, and stack gas scrubbers. In addition TVA is conducting research on improved scrubber designs and fluidized beds for future use of coal.

0140 Combustion

8572 **(ANL/ECT/TM—2) Preliminary assessment of coal-based industrial energy systems.** (Mittelhauser Corp., Downers Grove, IL (USA); Resource Engineering, Inc., Lexington, MA (USA)). Jan 1980. Contract W-31-109-ENG-38. 266p. NTIS, PC A12/MF A01.

This report presents the results of a study, performed by Mittelhauser Corp. and Resource Engineering, Inc. to identify the potential economic, environmental, and energy impacts of possible New Source Performance Standards for industrial steam generators on the use of coal and coal-derived fuels. A systems-level approach was used to take mine-mouth coal and produce a given quantity of heat input to a new boiler at an existing Chicago industrial-plant site. The technologies studied included post-combustion clean-up, atmospheric fluidized-bed combustion, solvent-refined coal liquids, substitute natural gas, and low-Btu gas. Capital and operating costs were prepared on a mid-1985 basis from a consistent set of economic guidelines. The cases studied were evaluated using three levels of air emission controls, two coals, two boiler sizes, and two operating factors. Only those combinations considered likely to make a significant impact on the 1985 boiler population were considered. The conclusions drawn in the report are that the most attractive applications of coal technology are atmospheric fluidized-bed combustion and post-combustion clean-up. Solvent-refined coal and probably substitute natural gas become competitive for the smaller boiler applications. Coal-derived low-Btu gas was found not to be a competitive boiler fuel at the sizes studied. It is recommended that more cases be studied to broaden the applicability of these results.

8573 **(DOE/ET/12328—T2) Coal combustion by wet oxidation.** Bettinger, J.A.; Lamparter, R.A.; McDowell, D.C. (Michigan Technological Univ., Houghton (USA). Center for Waste Management Programs). 15 Nov 1980. Contract FG22-78ET12328. 203p. NTIS, PC A10/MF A01.

The combustion of coal by wet oxidation was studied by the Center for Waste Management Programs, of Michigan Technological University. In wet oxidation a combustible material, such as coal, is reacted with oxygen in the presence of liquid water. The reaction is typically carried out in the range of 204°C (400°F) to 353°C (650°F) with sufficient pressure to maintain the water present in the liquid state, and provide the partial pressure of oxygen in the gas phase necessary to carry out the reaction. Experimental studies to explore the key reaction parameters of temperature, time, oxidant, catalyst, coal type, and mesh size were conducted by running batch tests in a one-gallon stirred autoclave. The factors exhibiting the greatest effect on the extent of reaction were temperature and residence time. The effect of temperature was studied from 204°C (400°F) to 260°C (500°F) with a residence time from 600 to 3600 seconds. From this data, the reaction activation energy of 2.7 x 10^4 calories per mole was determined for a high-volatile-A-Bituminous type coal. The reaction rate constant may be determined at any temperature from the activation energy using the Arrhenius equation. Additional data were generated on the effect of mesh size and different coal types. A sample of peat was also tested. Two catalysts were evaluated, and their effects on reaction rate presented in the report. In addition to the high temperature combustion, low temperature desulfurization is discussed. Desulfurization can improve low grade coal to be used in conventional combustion methods. It was found that 90% of the sulfur can be removed from the coal by wet oxidation with the carbon untouched. Further desulfurization studies are indicated.

8574 **(DOE/TIC—11381) Reactions of HS radicals important in coal combustion. Quarterly technical progress report, October-December 1980.** Wampler, F.B. (Los Alamos National Lab., NM (USA)). 31 Dec 1980. Contract W-7405-ENG-36. 14p. NTIS, PC A02/MF A01.

The primary objective of this research is to measure the rate constants and Arrhenius parameters for the reactions of the HS radicals that are pertinent in coal combustion chemistry. In the previous quarterly report, results in the development of a laser-induced fluorescence (LIF) diagnostic for HS radicals were presented. In this report, preliminary study of the reaction kinetics of the HS radicals under room-temperature conditions is presented.

8575 **(FE—7091-1) Electrocyclone development program. Quarterly technical report, August-October 1980.** Boericke, R.R. (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 14 Nov 1980. Contract AC01-80ET17091. 18p. NTIS, PC A02/MF A01.

Purpose of the program is to develop an electrostatically augmented cyclone for a high-efficiency, high-throughput gas cleanup device for pressurized fluidized bed combustion. An 18-in. dia electrocyclone is being tested. 8 figures. (DLC)

8576 **Production of energy from waste: fluidized bed combustion of low grade materials. Final report.** Minchener, A.J.; Rogers, E.A. Luxembourg; Commission of the European Communities (1980). 89p. (EUR—6823-EN). European Community Information Service, Washington, DC.

The feasibility of recovering useful heat from waste materials by combustion in a fluidized bed has been studied. An appraisal of the fluidized bed combustion process indicated that the technique was capable of accepting fuels of lower calorific value than conventional combustion processes, fuels of variable quality and in particular fuels with high sulfur contents. A survey of available and suitable waste materials in the UK is presented which identifies and quantifies possible feedstocks. When burning low grade fuels, high combustion efficiencies are essential and a review of factors influencing combustion efficiency in a fluidized bed was undertaken. This review highlighted the possibility of operating the system at temperatures higher than those normally accepted for the fluidized bed combustion process. A coal with an ash content of 55% was selected for an experimental program on a 0.3 m x 0.3 m fluidized bed combustor. In these tests a combustion efficiency of 97% was achieved when operating at 1.5 ms^{-1} and 1050°C with recycle of the primary cyclone fines. The data collected has been used for a process outline design of a 10 MW (thermal) fluidized bed boiler to burn this fuel. The program of work has shown that fluidized bed combustion can provide a means of burning, with heat recovery, materials which could not be considered as fuels in conventional combustion processes. The technique extends the range of fuels which can be economically exploited, thus conserving higher grade fuels, such as oil and gas, for premium usage.

8577 **Direct measurement of effective combustion rate constants of char particles in fluidized bed by step response curve.** Kono, H. Chicago, IL; Institute of Gas Technology (1980). 18p. (CONF-801104—11).

From 73. annual meeting of the American Institute of Chemical Engineers; Chicago, IL, USA (12 Nov 1980).

An experimental method for measuring effective combustion rate constants of fine char particles in a fluidized-bed combustion (FBC) system was developed. The results were compared with published reference data. It is not always possible to predict the effective combustion rate of a specified coal, so measuring the rate constant directly through experiments would have a significant impact on the design and operation of the FBC system. For this purpose, a measuring method for the effective combustion rate constant of char particles was developed by using a step response curve of product gas. The results of the experiment, which was performed on anthracite char and brown coal char, were compared with published reference data. Because various kinds of char will be used in the FBC system and a reliable estimation of the effective combustion rate constant from the properties of a specified char is not always possible, it would be significant for the operation and design of FBC to measure directly the rate constant by the method proposed in this study.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 8534, 9186, 9216

8578 **(DOE/ET/12548—2) Regional price targets appropriate for advanced coal extraction.** Terasawa, K.L.; Whipple, D.W. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Dec 1980. Contract AI01-76ET12548. 76p. (JPL-PUB—80-91). NTIS, PC A05/MF A01.

The object of the study is to provide a methodology for predicting coal prices in regional markets for the target time frames 1985 and 2000 that could subsequently be used to guide the development of an advanced coal extraction system. The model constructed for the study is a supply and demand model that focuses on underground mining, since the advanced technology is expected to be developed for these reserves by the target years. The supply side of the model is based on coal reserve data generated by Energy and Environmental Analysis, Inc. (EEA). Given this data and the cost of operating a mine (data from US Department of Energy and Bureau of Mines), the Minimum Acceptable Selling Price (MASP) is obtained. The MASP is defined as the smallest price that would induce the producer to bring the mine into production, and is sensitive to the current technology and to assumptions concerning miner productivity. Based on this information, market supply curves can then be generated. On the demand side of the model, demand by region is calculated based on an EEA methodology that emphasizes demand by electric utilities and demand by industry. The demand and supply curves are then used to obtain the price targets. This last step is accomplished by allocating the demands among the suppliers so that the combined cost of producing and transporting coal is minimized.

0160 Health And Safety

8579 **(LA—8618-PR) Radioactive emissions from coal production and utilization. Progress report, July 1, 1978-September 30, 1979.** Wagner, P.; Dreesen, D.R.; Wewerka, E.M.; Greiner, N.R. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 32p. NTIS, PC A03/MF A01.

Radioactivity from the uranium-238 and thorium-232 series was measured in a variety of coals and wastes from the coal-based power production cycle. Leachates prepared from these coals and wastes were also analyzed for radioactivity. For the most part, the radioactivity encountered in coals and coal-cleaning waste is about the same as that found in ordinary rocks and soils. The radioactivity in the ashes is generally about five times higher than in the coals. In some cases fly ash contains even higher levels of radioactivity, especially from the volatile radionuclides lead-210 and polonium-210. Lead-210 is the only radionuclide that appears to be readily leached from the solids.

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 9194, 9220, 9643

02 PETROLEUM

0201 Reserves

REFER ALSO TO CITATION(S) 8612

8580 **Mississippian and Pennsylvanian (carboniferous) systems in the United States: West Virginia and Maryland.** Arkle, T. Jr. (West Virginia Geological and Economic Survey, Morgantown); Beissel, D.R.; Larese, R.E.; Nuhfer, E.B.; Patchen, D.G.; Smosna, R.A.; Gillespie, W.H.; Lund, R.; Norton, C.W.; Pfefferkorn, H.W. *United States Department of the Interior, Geological Survey, Professional Paper (U.S.);* No. 1110D, vp(1979).

Early geologic work, physiography, structure, and mineral resources of the upper Paleozoic rocks underlying 81% of western and south West Virginia and much of Garrett County, smaller areas of Allegany County, and a few hilltops of Washington County in Maryland are reviewed. The paper focuses upon the lithostratigraphy and biostratigraphy of the formations. These formations include deposits of coal, oil, and natural gas that are very important to the two states. The development of these resources is briefly surveyed. 137 references. (BLM)

0203 Drilling And Production

8581 **(DOE/ET/12380—1(Vol.1)) Heavy oil reservoirs recoverable by thermal technology. Annual report.** Kujawa, P. (Science Applications, Inc., McLean, VA (USA)). Feb 1981. Contract AC03-78ET12380. 178p. NTIS, PC A09/MF A01.

The purpose of this study was to compile data on reservoirs that contain heavy oil in the 8 to 25° API gravity range, contain at least ten million barrels of oil currently in place, and are non-carbonate in lithology. The reservoirs within these constraints were then analyzed in light of applicable recovery technology, either steam-drive or in situ combustion, and then ranked hierarchically as candidate reservoirs. The study is presented in three volumes. Volume I presents the project background and approach, the screening analysis, ranking criteria, and listing of candidate reservoirs. The economic and environmental aspects of heavy oil recovery are included in appendices to this volume. This study provides an extensive basis for heavy oil development, but should be extended to include carbonate reservoirs and tar sands. It is imperative to look at heavy oil reservoirs and projects on an individual basis; it was discovered that operators, and industrial and government analysts will lump heavy oil reservoirs as poor producers, however, it was found that upon detailed analysis, a large number, so categorized, were producing very well. A study also should be conducted on abandoned reservoirs. To utilize heavy oil, refiners will have to add various unit operations to their processes, such as hydrotreaters and hydrodesulfurizers and will require, in most cases, a lighter blending stock. A big problem in producing heavy oil is that of regulation; specifically, it was found that the regulatory constraints are so fluid and changing that one cannot settle on a favorable recovery and production plan with enough confidence in the regulatory requirements to commit capital to the project.

8582 **(DOE/ET/12380—1(Vol.2)) Heavy oil reservoirs recoverable by thermal technology. Annual report.** Kujawa, P. (Science Applications, Inc., McLean, VA (USA); Department of Energy, Oakland, CA (USA)). Feb 1981. Contract AC03-78ET12380. 529p. NTIS, PC A23/MF A01.

This volume contains reservoir, production, and project data for target reservoirs which contain heavy oil in the 8 to 25° API gravity range and are susceptible to recovery by in situ combustion and steam drive. The reservoirs for steam recovery are less than 2500 feet deep to comply with state-of-the-art technology. In cases where one reservoir would be a target for in situ combustion or steam drive, that reservoir is reported in both sections. Data were collectd from three source types: hands-on (A), once-removed (B), and twice-removed (C). In all cases, data were sought depicting and characterizing individual reservoirs as opposed to data covering an entire field with more than one producing interval or reservoir. The data sources are listed at the end of each case. This volume also contains a complete listing of operators and projects, as well as a bibliography of source material.

8583 **(DOE/ET/12380—1(Vol.3)) Heavy oil reservoirs recoverable by thermal technology. Annual report.** Kujawa, P. (Science Applications, Inc., McLean, VA (USA); Department of Energy, Oakland, CA (USA)). Feb 1981. Contract AC03-78ET12380. 339p. NTIS, PC A07/MF A01.

This volume contains reservoir, production, and project data for target reservoirs thermally recoverable by steam drive which are equal to or greater than 2500 feet deep and contain heavy oil in the 8 to 25° API gravity range. Data were collected from three source types: hands-on (A), once-removed (B), and twice-removed (C). In all cases, data were sought depicting and characterizing individual reservoirs as opposed to data covering an entire field with more than one producing interval or reservoir. The data sources are listed at the end of each case. This volume also contains a complete listing of operators and projects, as well as a bibliography of source material.

8584 **(SAND—80-2215) Heavy Oil Program. Quarterly progress report No. 1, April 1-June 30, 1980.** Wayland, J.R.; Bartel, L.C.; Johnson, D.R.; Fox, R.L. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1980. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01.

Research and development efforts in support of the DOE Heavy Oil RD & D Program in reservoir access were initiated. Preliminary activities in the survey of sand control, drilling, and fracturing techniques in heavy oil formations are described. The continued development of a high temperature packer for use in steam injection applications is presented. A new application of controlled source audio magnetotelluric survey to developing thermal fronts from in situ combustion and steam drive is described.

8585 **(SAND—80-2631) Project Deep Steam. Quarterly report, April 1-June 30, 1980.** Fox, R.L.; Clay, R.G.; Donaldson, A.B.; Eisenhawer, S.W.; Johnson, D.R.; Lyle, W.D.; Mulac, A.J. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 45p. NTIS, PC A03/MF A01.

Objective of Project DEEP STEAM is to develop the technology required to economically produce heavy oil from deep reservoirs. The tasks included in this project are development of thermally efficient delivery systems and downhole steam generation systems. The initial field testing of a downhole steam generator design which was operated on the surface has been completed this quarter. This field test was begun in January 1980 and completed in May. Design and fabrication of downhole generator systems for the next phase of testing are under development. Full scale simulation tests of thermally efficient delivery strings at the Tacoma, Washington, test facility have continued. A comparison of two designs for calcium silicate insulated strings has demonstrated significant reduction in casing temperature can be achieved by changes in joint design.

0204 Processing

8586 **(DOE/RA—0010(Rev.12-80)) Trends in refinery capacity and utilization: petroleum refineries in the United States, foreign refinery exporting centers.** Peer, E.L.; Marsik, F.V.; Hutchins, J.F. (Department of Energy, Washington, DC (USA). Assistant Secretary for Resource Applications). Dec 1980. 86p. NTIS, PC A05/MF A01.

The purpose of this report is to examine United States and foreign refining capacities. Specifically, the report examines the growth of domestic crude oil distillation and downstream processing capacities. The report also examines the growth of foreign refineries in countries which are capable of exporting products to the United States. These data can be used to evaluate planned growth in US and foreign refinery capacities to give a perspective on the US product import situation.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 8612

8587 **(DOE/PE—0024) United States petroleum pipelines: an empirical analysis of pipeline sizing.** Coburn, L.L. (Department of Energy, Washington, DC (USA). Office of Competition). Dec 1980. 482p. NTIS, PC A21/MF A01.

The United States Petroleum Pipelines: An Empirical Analysis of Pipeline Sizing Study (Study) uses data gathered by the Department of Energy (DOE) to test whether the operations of any petroleum pipeline fall within the petroleum pipeline undersizing theory hypothesized by the Department of Justics (DOJ). The study was undertaken in response to legislative and agency rulemaking proposals that could require the divestiture of petroleum pipelines by their oil company owners. The undersizing theory hypothesizes that integrated oil companies have a strong economic incentive to size the petroleum pipelines they own and ship over in a way that means that some of the demand must utilize higher cost alternatives. The DOJ theory posits that excess or monopoly profits are earned due to the natural monopoly characteristics of petroleum pipelines and the existence of market power in some pipelines at either the upstream or downstream market. The theory holds that independent petroleum pipelines owned by companies not otherwise affiliated with the petroleum industry (independent pipelines) do not have these incentives and all the efficiencies of pipeline transportation are passed to the ultimate consumer. Integrated oil companies, on the other hand, keep these cost efficiencies for themselves in the form of excess profits.

8588 **(EMD—80-98) United States exerts limited influence on the international crude oil spot market.** Staats, E.B. (General Accounting Office, Washington, DC (USA)). 21 Aug 1980. 43p. GPO.

Report to the Congress by the Comptroller General of the United States.

In 1979, volume grew on the crude oil spot market, where oil is exchanged on a day-to-day basis rather than under long-term contract. While world prices for crude oil sold under contract more than doubled, spot market prices rose even higher. Conditions underlying the 1979 volatility of the international crude oil spot market remain - they underscore the need for understanding the effects of Government programs and actions on that market. The United States and six other oil-importing countries pledged at the Tokyo summit in June 1979 to try to moderate spot market activity, but the United States has no program to influence directly US oil company involvement in the spot market. Some Department of Energy programs primarily designed for domestic goals have an influence by, for example, affecting companies' crude oil acquisition costs. However, some encourage and some discourage spot market purchases. These diverse effects make it difficult for the United States to pursue a coherent policy.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 8613, 9615

8589 **(AD-A—083014) The windwave and turbulence observation program (WAVTOP). The measurement of parameters controlling downward mixing of oil from the sea surface.** (Naval Underwater Systems Center, Newport, RI (USA)). May 1979. Contract MIPR-Z-70099-7-71825-A. 103p. NTIS, PC A06/MF A01.

The wave and turbulence observation program (WAVTOP) has developed instrumentation and techniques to gather field data of the wind-generated motions in the upper ocean. The sensor package (BLT) includes small fast-response impellers and a capacitance wave staff system to measure particle velocity components and free surface elevation to determine shear, kinetic and potential energy content, and Reynolds stresses in the upper 5-10m. The battery-powered recording system utilizes a microprocessor digitizer programmable for data sampling. Preliminary measurements were made with the BLT mounted on the AESOP Stable Spar Buoy and from a fixed boom on Gould Island. Results portray kinetic energy attenuating exponential with depth and correlating with the local wind speed. The vertically integrating energy appears to correlate with the cube of the wind speed with a 15-20 min time lag. Autospectra of the velocity data display narrow peaks demonstrating the monochromaticity of small wind waves. The spectra verify the attenuation of the wave energy with depth. Higher frequency (wave number) energy persists at deeper depths suggesting the presence of ambient turbulence. Reynolds stresses show fluctuations with time but display downward momentum flux and range from 1-2 dyne/cm2 for winds from 4-5 m/sec.

8590 **(NP—25212) OCS oil and gas proposed 1981 sales A66 and 66. Final environmental impact statement.** (Bureau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office). Dec 1980. 241p. NTIS, PC A11/MF A01.

Proposed OCS Sales A66 and 66 are scheduled for July and October 1981, respectively, in accordance with the Department of the Interior's Final 5-Year OCS Oil and Gas Leasing Schedule (June 1980). The two proposed sales will offer 385 tracts totalling 1,979,794 acres in federal waters. Of these tracts, 209 totalling approximately 1,081,553 acres comprise Sale 66 offshore Alabama, Florida, Mississippi, and a portion of Louisiana; 176 tracts totalling 898,241 acres comprise Sale A66 offshore Texas and a portion of Louisiana. These tracts range from approximately 3-116 nmi offshore and are located in water depths of approximately 2-500 m. Basic assumptions for impact estimates and analysis of potential environmental consequences are presented. In the area of transportation, the mean resource estimate development scenarios assume production offshore Texas and Louisiana will be transported to shore by connecting to existing trunk pipelines. Production offshore Florida will be gathered by new pipelines to a central point for storage and transfer by shuttle tankers to existing onshore processing facilities. In the area of cumulative impact assumptions on transportation, gas production off Texas could contribute to the eventual construction of one additional gas pipeline with landfall in Texas, and oil production off Louisiana likewise could contribute to one additional pipeline to the Louisiana coastline. One final assumption states that increased production of oil offshore Florida could contribute to the eventual construction of one trunk pipeline with landfall somewhere between Naples and Tampa Bay. From the eleven general areas of concern expressed at the public scoping meetings three significant environmental issues were identified for further examination: recreational fishing; biologically sensitive areas; and West Indian Manatee.

0220 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 8587

0230 Properties

REFER ALSO TO CITATION(S) 8646

8591 **(AD-A—083389) Chemical demulsification of tanker crude emulsions. Memorandum report.** Little, R.C. (Naval Research Lab., Washington, DC (USA)). 13 Feb 1980. 57p. NTIS, PC A04/MF A01.

The chemical demulsification of tanker crude emulsions was studied as a function of oil type (light vs. heavy crude), demulsifier concentrations, and temperature. Aerosol OT shows promise as a chemical demulsifier of tanker crude emulsions provided that ambient temperatures are not too cold and that an appropriate concentration range is used for specific oil. The evaporation rates and viscosities of the six crudes studied are also reported in the text.

8592 **(AD-A—083610) Development of Army fire-resistant diesel fuel. Interim report, 1 October 1977-31 December 1979.** Weatherford, W.D. Jr.; Fodor, G.E.; Naegeli, D.W.; Owens, E.C.; Wright, B.R. (Southwest Research Inst., San Antonio, TX (USA). Army Fuels and Lubricants Research Lab.). Dec 1979. Contracts DAAK70-78-C-0001;DAAK70-80-C-0001. 132p. NTIS, PC A07/MF A01.

Six different approaches to achieving reduced fuel fire vulnerability investigated by the U.S. Army have been described. The last approach was selected for developing fire-resistant fuels (FRF) for diesel-powered ground equipment. The selected approach involves the inclusion of emulsified water in surfactant-stabilized diesel fuel. An alternative approach, using half as much water and trace amounts of antimist agent in surfactant-stabilized diesel fuel, also has been investigated. Screening studies followed by laboratory, bench-scale, and full-scale experimental investigations have led to the development of clear-to-hazy fire-resistant microemulsions of 10 percent volume water and 6 percent volume surfactant (FRF-A) and alternatively, of 5 percent volume water and 3 percent volume surfactant with 0.2 wt% antimist agent (FRF-B), both formulated in DF-2 diesel fuel. The surfactant comprises a mixture of reaction products formed from two moles of diethanolamine and mole of oleic acid, or 1.009 moles of oleic acid in a modified version of the surfactant. Flammability evaluations demonstrate that these aqueous microemulsions yield diminished mist flammability while either eliminating pool burning or providing rapid self-extinguishment of pool fires, even at fuel temperatures more than 10 degrees C above the base fuel flash point. Bench-scale ballistic tests, using 20-mm high-explosive incendiary tracer projectiles, and full-scale ballistic tests, using 3.2-inch precision shaped charges, confirm and correlate with the flammability data.

0240 Storage

8593 **(SAND—80-2143) Strategic petroleum reserve data acquisition system.** Merillat, P.D.; Bauer, A.G. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1980. Contract AC04-76DP00789. 180p. NTIS, PC A09/MF A01.

The Strategic Petroleum Reserve Data Acquisition System is a general purpose, digital data acquisition system designed for field

use in the DOE's Strategic Petroleum Reserve testing and monitoring program. The system is computer driven, under the control of an operator. The system is designed to allow the operator to perform pre-test system configuration; test monitoring and control; and post test analysis. This document is a system description and an operator users manual. Topics covered include: configuration and running on-line tests, software documentation, and maintenance programming information.

8594 **(SAND—80-2691) Time step dependence of creep calculations.** Preece, D.S. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 20p. NTIS, PC A02/MF A01.

Creep calculations in support of the Strategic Petroleum Reserves require the use of an incremental solution with respect to time. The creep algorithms use a time step supplied by the user. Larger time steps may give erroneous results even though the computer is stable. This report presents the theory behind such problems and some examples showing several different solutions obtained where all circumstances were identical except the size of the time step.

03 NATURAL GAS

0302 Geology And Exploration

8595 **(METC/EGSP—103) Section number one, stratigraphic cross section, Southwestern New York showing correlation of middle and upper Devonian rocks.** Van Tyne, A.M.; Rickard, L.V.; Corbo, S.; Kamakaris, D.G. (New York State Museum and Science Service, Albany (USA)). 1980. Contract AS21-76ET12014. 55p. NTIS, PC A04/MF A01.

8596 **(METC/EGSP—124) Section number five, stratigraphic cross section, western New York showing correlation of middle and upper Devonian rocks.** Van Tyne, A.M.; Corbo, S.; Kamakaris, D.G. (New York State Museum and Science Service, Albany (USA)). 1980. Contract AS21-76ET12014. 50p. NTIS, PC A03/MF A01.

8597 **(METC/EGSP—126) Isopach of radioactive shale in the Java formation (> 20 API units above shale baseline).** Van Tyne, A.M.; Kamakaris, D.G.; Corbo, S. (New York State Museum and Science Service, Albany (USA); New York State Geological Survey, Alfred (USA)). 1980. Contract AS21-76ET12104. 40p. NTIS, PC A03/MF A01.

8598 **(METC/EGSP—127) Isopach of radioactive shale in the West Falls formation (> 20 API units above shale baselines).** Van Tyne, A.M.; Kamakaris, D.G.; Corbo, S. (New York State Museum and Science Service, Albany (USA); New York State Geological Survey, Alfred (USA)). 1980. Contract AS21-76ET12014. 40p. NTIS, PC A03/MF A01.

8599 **(METC/EGSP—129) Isopach of radioactive shale in the Genesee Group (> 20 API units above shale base line).** Van Tyne, A.M.; Kamakaris, D.G.; Corbo, S. (New York State Museum and Science Service, Albany (USA); New York State Geological Survey, Alfred (USA)). 1980. Contract AS21-76ET12014. 50p. NTIS, PC A03/MF A01.

8600 **(METC/EGSP—130) Isopach of radioactive shale in the Hamilton group (> 20 API units above shale baseline).** Van Tyne, A.M.; Kamakaris, D.G.; Corbo, S. (New York State Museum and Science Service, Albany (USA); New York State Geological Survey, Alfred (USA)). 1980. Contract AS21-76ET12014. 72p. NTIS, PC A04/MF A01.

8601 **(METC/EGSP—131) Isopach of radioactive shale in the Sonyea group (> 10 API units above shale baseline).** Van Tyne, A.M.; Kamakaris, D.G.; Corbo, S. (New York State Museum and Science Service, Albany (USA); New York State Geological Survey, Alfred (USA)). 1980. Contract AS21-76ET12014. 50p. NTIS, PC A03/MF A01.

8602 **(METC/EGSP—205) Preliminary cross section (A-D-A') of middle and upper Devonian in West Virginia.** Neal, D.W. (West Virginia Geological and Economic Survey, Morgantown (USA)). 1980. Contract AC21-76ET12130. 35p. NTIS, PC A03/MF A01.

8603 **(METC/EGSP—206) Preliminary cross section (A-C) of middle and upper Devonian in West Virginia.** Dowse, M.E. (West Virginia Geological and Economic Survey, Morgantown (USA)). 1980. Contract AC21-76ET12130. 60p. NTIS, PC A04/MF A01.

8604 **(METC/EGSP—207) Preliminary cross section (D-D') of middle and upper Devonian in West Virginia.** Schwietering, J.F. (West Virginia Geological and Economic Survey, Morgantown (USA)). 1980. Contract AC21-76ET12130. 50p. NTIS, PC A03/MF A01.

8605 **(METC/EGSP—208) Preliminary cross section (D'-D") of middle and upper Devonian in West Virginia.** Schwietering, J.F. (West Virginia Geological and Economic Survey, Morgantown (USA)). 1980. Contract AC21-76ET12130. 140p. NTIS, PC A07/MF A01.

8606 **(METC/EGSP—209) Preliminary cross section (B-D'-B') of middle and upper Devonian in West Virginia.** Schwietering, J.F. (West Virginia Geological and Economic Survey, Morgantown (USA)). 1980. Contract AC21-76ET12130. 80p. NTIS, PC A05/MF A01.

8607 **(METC/EGSP—210) Preliminary cross section (C-C') of middle and upper Devonian in West Virginia.** Schwietering, J.F. (West Virginia Geological and Economic Survey, Morgantown (USA)). 1980. Contract AC21-76ET12130. 110p. NTIS, PC A06/MF A01.

8608 **(METC/EGSP—211) Preliminary cross section (A'-B'-D") of middle and upper Devonian in West Virginia.** Schwietering, J.F. (West Virginia Geological and Economic Survey, Morgantown (USA)). 1980. Contract AC21-76ET12130. 100p. NTIS, PC A05/MF A01.

8609 **(METC/EGSP—810) Map of Indiana showing thickness of the Ellsworth member of the New Albany Shale (Devonian and Mississippian).** Bassett, J.L.; Hasenmueller, N.R. (Indiana Geological Survey, Bloomington (USA)). 1980. Contract AC21-76ET12121. 32p. NTIS, PC A03/MF A01.

8610 **Mineralogy and diagenesis of low-permeability sandstones of late cretaceous age, Piceance Creek Basin, northwestern Colorado.** Hansley, P.L.; Johnson, R.C. (Geological Survey, Denver, CO). 17: No. 4, 88-106(Oct 1980).

This report presents preliminary results of a mineralogic and diagenetic study of some low-permeability sandstones from measured surface sections and cores obtained from drill holes in the Piceance Creek Basin of northwestern Colorado. These sandstones are in the nonmarine upper part of the Mesaverde Formation (or group) of Late Cretaceous age and are separated from overlying lower Tertiary rocks by a major regional unconformity. Attention is focused on the sandstone units of the Ohio Creek Member, which directly underlies the unconformity; however, comparisons between the mineralogy of the Ohio Creek strata and that of the underlying sandstone units are made whenever possible. The Ohio Creek is a member of the Hunter Canyon Formation (Mesaverde Group) in the southwestern part of the basin, and the Mesaverde Formation in the southern and central parts of the basin. The detrital mineralogy is fairly constant throughout all of these nonmarine Cretaceous sandstone units; however, in the southeastern part of the basin, there is an increase in percentage of feldspar, quartzite, and igeneous rock fragments in sandstones of the Ohio Creek Member directly underlying the unconformity. In the southwestern part of the basin, sandstones of the Ohio Creek Member are very weathered and are almost entirely comprised of quartz, chert, and kaolinite. A complex diagenetic history, partly related to the overlying uncon-

formity, appears to be responsible for transforming these sandstones into potential gas reservoirs. The general diagenetic sequence for the entire Upper Cretaceous interval studied is interpreted to be (early to late): early, calcite cement, chlorite, quartz overgrowths, calcite cement, secondary porosity, analcime (surface only), kaolinite and illite, and late carbonate cements.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 8565

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 9215

8611 **World gas option: symposium papers.** Chicago, IL; Institute of Gas Technology (1980). 193p. (CONF-800353—). $25.00.

From World gas option symposium; Washington, DC, USA (26 Mar 1980).

Nine papers were presented at the Institute of Gas Technology's symposium The World Gas Option in Washington, DC. Subjects discussed were: an assessment of world gas reserves; current world production patterns; possibilities and projections for future production; international transport of gas; the expanding roles of international pipelines and LNG; the policies of exporting and importing organizations; the role of gas for oil exporting countries; the impact of technological advances on gas supplies; and conservation and its impact on gas use. Abstracts are available for these papers. The symposium concluded with a panel of international authorities presenting their views of future utilization of natural gas.

8612 **World oil and natural gas reserves, resources and production potential: growing potential for natural gas trade.** Franssen, H. (Dept. of Energy, Washington, DC). pp 13-29 of World gas option: symposium papers. Chicago, IL; Institute of Gas Technology (1980).

From World gas option symposium; Washington, DC, USA (26 Mar 1980).

At year end 1979, the crude oil proved reserves in the world totaled 642 billion barrels, and proved reserves of natural gas totaled 2573 trillion cubic feet (Tcf) which are equal to about 71 percent of the caloric value of world oil reserves. Total accumulative world oil production was approximately 391 billion barrels of oil and 1012 Tcf of natural gas (equivalent of 181 billion barrels of oil). A total of 1033 billion barrels of oil has been discovered in the world, of which over one-third has been depleted. In regard to natural gas, 3585 Tcf has been discovered, of which over one-fourth has been depleted. Compared with oil, natural gas has been relatively under utilized. Over one-half or 58 percent of crude oil proved reserves exists in the Middle East. The next largest concentration of reserves is in the USSR and eastern Europe, 12 percent; and with 9 percent, Africa is the third largest area of reserves. North America, with 8 percent of the world reserves, or 50.5 billion barrels, is the fourth largest area of proved reserves. Over one-third of the natural gas reserves of the world are located in the Soviet Bloc, slightly over one-fourth of the world total is in the Middle East, and only one-eighth of the world total proved reserves of natural gas are found in North America. Total world trade in natural gas is projected to more than double; from about 4.1 Tcf in 1978 to possibly as much as 10 to 11 Tcf by 1990. OPEC countries are estimated to increase natural gas exports from about 1 Tcf in 1978 to between 4.5 and 5.5 Tcf by 1990. Even at the accelerated rate of growth in natural gas utilization in the free world, only 28 percent of current free world gas reserves would be consumed. By contrast, with only very small growth in free world oil consumption, some 40 percent of free world oil reserves would be consumed by 1990.

0308 Environmental Effects

REFER ALSO TO CITATION(S) 8590, 9686

8613 (DOE/EV—0128, pp 61-76) **Petroleum and gas.** Jun 1980.

In Division of Environmental Control Technology Program, 1979.

This section on petroleum and gas focuses on developing safety and environmental control information for liquefied natural gas, liquefied petroleum gas and liquid hydrogen. The program discussed here deals primarily with wastewater treatment options including the prevention and cleanup of marine oil spills using the burning technique. (KRM)

0309 Artificial Stimulation

8614 **(DOE/BC/10003—17) Western Gas Sands Project. Status report, 1 September-30 September 1980.** (CER Corp., Las Vegas, NV (USA)). 1980. Contract AC08-79BC10003. 74p. NTIS, PC A04/MF A01.

The progress during September of government-sponsored projects, directed towards increasing gas production from low permeability gas sands of the Western United States, is summarized. Coring operations began at the Mountain Fuel Supply Mesa Unit No. 1 well, Pinedale Field, Sublette County, Wyoming. Negotiations are still being conducted with Superior Oil Company to acquire a 640-acre lease in Garfield County, Colorado, for the Piceance Basin multi-well experiment. During September, LLL continued exploration of the use of polycarbonate to study fluid flow in cracks. An important milestone was passed this month at LASL with the measurement of transverse relaxation time on WGSP core in simulated downhole geometry. A strain-relaxation technique to determine maximum and minimum horizontal stresses from oriented core has been demonstrated on NTS core by Sandia National Laboratories.

0350 Storage

REFER ALSO TO CITATION(S) 8646

04 OIL SHALES AND TAR SANDS

0402 Site Geology And Hydrology

REFER ALSO TO CITATION(S) 8595, 8596, 8597, 8598, 8599, 8600, 8601, 8602, 8603, 8604, 8605, 8606, 8607, 8608, 8609, 9646

8615 **(UCID—18891) Utilization of oil shales and basic research in organic geochemistry.** Burnham, A.K. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 13 Jan 1981. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01.

This report summarizes current research needs relating to oil shale utilization which might also provide new insight into the organic geochemistry of the Green River formation. There are two general topics which cross boundaries and are particularly worthy of emphasis. The first is a study of changes in the kerogen structure and biological markers with depth and location, and how these changes affect the pyrolysis products. This information would be particularly useful to the retort diagnostic methods. It might also lead to a better chemical reaction model of diagenesis and metagenesis. The second is a study of the heteroatom chemistry of the kerogen and how it relates to mineral matter and trace metals. This would be useful not only to present utilization methods, but also might suggest new nonthermal methods of organic materials recovery.

0404 Oil Production, Recovery, And Refining

8616 **(DOE/LC/10003—T3) Validation and analysis of steady-state operating data from the Paraho Semiworks retort. Volume I. Final report.** Laird, D.H.; Stamm, P.L. (JAYCOR, Del Mar, CA (USA)). 30 Jul 1980. Contract AC20-79LC10003. 168p. NTIS, PC A08/MF A01.

A major series of aboveground oil shale retorting experiments was done by Development Engineering, Inc., a subsidiary of PARAHO, in its Semiworks and pilot plant retorts at Anvil Points, Colorado. The retorts are the gas-combustion type using a slowly descending packed bed of large shale particles heated by forward combustion of upward-flowing gas. This report describes analysis of 176 steady-state Semiworks experiments done from 1975 through 1978. Of these, 142 are reasonably self-consistent, well understood, and suitable for intercomparison and correlation. The remainder contains intractable data flaws. Correlations are to be developed from the acceptable group of experiments during the final phase of this project.

8617 **(UCID—16986-80-3) Lawrence Livermore National Laboratory oil shale project. Quarterly report, July-September 1980.** Rothman, A.J. (ed.). (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Dec 1980. Contract W-7405-ENG-48. 25p. NTIS, PC A02/MF A01.

Settling bed oil shale retorts can be operated on a small scale without internal equipment (such as air distributors) provided that there are sufficient instruments and controls to determine what is happening in the retort, permitting adjustment of the various flow rates. Variation of retorting rate from 38 to 73 m/d had little effect upon the oil yield or properties. Decreasing the air content of the feed gas reduces retorting temperatures and heating rates, which results in less mineral carbonate decomposition, less organic char reaction, lower oil pour points and lower oil viscosities. Problems in solids flow occur using finer shale particles, due presumably to excessive oil holdup and coking.

8618 **(UCID—18897) Oil shale project run summary. Small retort run S-18.** Ackerman, F.J.; Sandholtz, W.A.; Raley, J.H.; Tripp, L.J.; Carley, J.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1980. Contract W-7405-ENG-48. 68p. NTIS, PC A04/MF A01.

Retort Run S-18 was a combustion run on June 13 to 14, 1979, using a 50% air-50% steam mixture. Results are compared with S-14, which was more ordered than S-18. (DLC)

8619 **(UCID—18899) LLL oil shale project small retort run summary. Run S-17.** Sandholtz, W.A.; Ackerman, F.J.; Raley, J.H.; Carley, J.F.; Tripp, L.J. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Dec 1980. Contract W-7405-ENG-48. 67p. NTIS, PC A04/MF A01.

Run S-17 was conducted on May 3 and 4, 1978, using an air and nitrogen mixture. Results indicate that when steam is used instead of nitrogen, more shale is retorted, and more oil is produced.

8620 **(UCRL—84048(Rev.1)) Possible mechanism of alkene/alkane production in oil shale retorting.** Burnham, A.K.; Ward, R.L. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 26 Nov 1980. Contract W-7405-ENG-48. 20p. (CONF-800889—1(Rev.1)). NTIS, PC A02/MF A01.

From Symposium on oil shale, tar sands, and related materials; San Francisco, CA, USA (Aug 1980).

The objective was to clarify the reaction mechanisms that determine the observed alkene/alkane ratios under various conditions. When oil shale is pyrolyzed either isothermally or nonisothermally, the hydrocarbon and hydrogen concentrations are all time dependent. To determine if the alkene-alkane-hydrogen system is at equilibrium, oil shale was heated at a constant rate and the C_1 to C_3 hydrocarbons and hydrogen were measured over time. The effect of an inert sweep gas on the time-dependent ethene/ethane and propene/propane ratios and the integral 1-alkene/n-alkane ratios in the oil were also measured. When oil shale was heated at a constant rate, the alkene/alkane ratios in the evolved hydrocarbon gases changed with time. In addition, the alkene/alkane ratios in both the gas and the oil were affected by an inert sweep gas. The ethene/ethane ratio was not determined by equilibrium with hydrogen, and this phenomenon was interpreted in terms of a free-radical cracking mechanism. The implication is that alkene/alkane ratios, especially the ethene/ethane ratio, can be used as an indicator of retort performance only if the correct relationships are used for each set of retort conditions.

8621 **(UCRL—84913) Chemistry of shale oil cracking.** Burnham, A.K. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 26 Nov 1980. Contract W-7405-ENG-48. 27p. (CONF-800889—3). NTIS, PC A03/MF A01.

From Symposium on oil shale, tar sands, and related materials; San Francisco, CA, USA (Aug 1980).

Results for thermal cracking of shale oil vapor over shale are presented. Cracking temperatures of 504 to 610°C and residence times of 2 to 11 seconds were studied. A first-order Arrhenius rate expression and associated stoichiometry were given. Changes in oil properties caused by thermal cracking are also discussed. Cracking increases nitrogen content and decreased the H/C ratio and pour point of the recovered oil. Spectroscopic evidence related the decrease in H/C ratio to an increase in aromatic and alkene content of the oil. Gas-phase oil cracking was contrasted to liquid-phase oil coking as a loss mechanism in oil shale retorting. Results for oils prepared in the laboratory were also compared with oil prepared in the TOSCO-II semi-works and in modified and true in-situ combustion retorts. It was demonstrated that the naphthalene/2-methylnaphthalene ratio is a good indictor of cracking temperature in an oil shale retort.

8622 **Simultaneous fluid-solid reactions in porous solids: reactions between one solid and two fluid reactants.** Sohn, H.Y.; Braun, R.L. (Lawrence Livermore Lab., CA). *Chemical Engineering Science (England);* **35**: No. 7, 1625-1635(1980).

A general model describing simultaneous independent reactions between one solid reactant and two fluid reactants is presented. Such reaction systems are attracting much attention in the areas of oil shale retorting, direct reduction of metal oxides with reformed natural gas, coal gasification, etc. The model has been formulated in general terms so as to allow the incorporation of specific details of an actual system. The law of additive reaction times previously proposed for single fluid-solid reactions has been applied to the reaction system under consideration, and it has yielded useful approximate solutions for various aspects of the simultaneous reactions, which otherwise must be obtained by numerical methods.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 8620

8623 **(UCRL—84066(Rev.1)) Hydrogen sulfide evolution from Colorado oil shale.** Burnham, A.K.; Bey, N.K.; Koskinas, G.J. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 26 Nov 1980. Contract W-7405-ENG-48. 25p. (CONF-800889—2(Rev.1)). NTIS, PC A02/MF A01.

From Symposium on oil shale, tar sands, and related materials; San Francisco, CA, USA (Aug 1980).

The dependence of H_2S evolution on gas atmosphere was measured in this study. The gas environments used were argon, autogenous (self-generated), and steam-argon mixtures, all at atmospheric pressure. The samples used in these experiments were Green River oil shale from Colorado. In Green River oil shale, sulfur occurs in both inorganic and organic combinations; 70 to 85% of the sulfur is present as pyrite, and most of the remaining sulfur is present as organic sulfur. During pyrolysis, H_2S could be formed from the reaction of pyrite with hydrocarbons, hydrogen, or water, and from cracking or organosulfur compounds. The objective was to determine the importance of these various reactions and to report the amounts of H_2S evolved from oil-shale samples obtained from locations in Colorado. Most of the sulfur in oil shale occurs in pyrite and a smaller amount is contained in the kerogen. The major sources of H_2S during oil shale pyrolysis appears to be the reaction

of pyrite with organic matter. In an autogenous atmosphere, most of the H_2S evolves between 400 and 500°C. Addition of finely ground pyrite increases the amount of H_2S evolved but does not change the evolution profile. In an argon atmosphere, however, added pyrite causes a substantial increase in H_2S evolution only between 475 and 525°C. Similar reaction characteristics were observed with large-grained natural pyrite in Tract C-a shale. The argon results demonstrate the importance of intimate contact between the pyrite and organic material. In a steam atmosphere, pyrite is oxidized to iron oxides and the H_2S evolution increases substantially. In some samples, essentially all the initial sulfur is evolved as H_2S at temperatures below 800°C. However, thermodynamics may limit the amount of H_2S produced from pyrrhotite under retort conditions.

8624 **Characterization of oil shales by differential scanning calorimetry.** Rajeshwar, K.; Jones, D.B.; DuBow, J.B. (Colorado State Univ., Fort Collins). *Analytical Chemistry (U.S.);* **53**: No. 1, 121-122(Jan 1981).

Oil shale blocks were cored to suitable dimensions (nominally 2.5 cm diameter and 1 cm thick). Specific gravity measurements were then carried out on these cylindrical cores to determine the organic content. Selected samples were also assayed at Laramie Energy Technology Center, WY, by the pulsed NMR technique. Oil yields obtained by the two methods on identical cores were in agreement with the limits of experimental error (vide infra). The cored shale samples were crushed to particles which passed through 100-mesh sieves. Ten to fifteen milligram batches of these crushed shale particles were then subjected to enthalpy measurements in the differential scanning calorimetry assembly. A sample of kerogen concentrate was obtained from Laramie Energy Technology Center. DSC measurements were carried out on a DuPont 990 thermal analysis system fitted with the DSC accessory module. All measurements were carried out in a flowing atmosphere of prepurified N_2. A heating rate of 10°C/min was employed for the enthalpy determinations. The fusion endotherm of zinc (mp 419.4°C, ΔH/sub f/ = 27.05 cal/g) was used as the calibration standard. The linear correlation that was observed between the enthalpy of decomposition of the organic matter (ΔH) and oil yields for Green river oil shales suggests that this technique might be useful as a rapid screening tool for resource evaluation of an oil shale deposit.

0408 Marketing And Economics

REFER ALSO TO CITATION(S) 9218

0409 Waste Research And Management

REFER ALSO TO CITATION(S) 8558, 8560

8625 **(DOE/LETC/10787—68) Irrigation experiments with produced waters from the retorting of oil shale.** Hutchinson, D.L. (Geokinetics, Inc., Concord, CA (USA)). Dec 1980. Contract FC20-78LC10787. 11p. NTIS, PC A02/MF A01.

The research described herein was conducted by Geokinetics to qualitatively assess the tolerance of native and certain introduced species of vegetation to irrigation with produced water from the retorting of oil shale. Two separate experiments were conducted at the Kamp Kerogen field site in Uintah County, Utah. The results indicate possible effects on vegetation that a prolonged exposure to produced water would have. The two simple experiments were initiated during the summer of 1979. It was expected that irrigation with produced water would eventually result in detrimental effects to the plants receiving it; the concentrations of boron, molybdenum, arsenic, oil and other constituents in untreated production waters are high enough to likely cause damage to plants. In one experiment a 27 foot by 27 foot plot of native vegetation was irrigated with one inch of produced water per week for five weeks using a lawn sprinkler. Grasses and shrubs within the test plot appeared to have died; germination of annual plants was greatly inhibited. In the other experiment, 30 container-grown seedlings ranging in height from 0.3 feet to 3.0 feet were transplanted. Six species of broadleaf, deciduous trees not native to the test site were represented by five seedlings each. All 30 trees received well water irrigation for one month, after which four trees of each species were irrigated with produced water for seven weeks. One tree of each species continued to receive well water throughout the experiment; only two of those trees survived the summer of 1979. All six species appeared to have been adversely affected by produced water. The horse chesnut trees were the hardiest of the species planted. Most of the 30 trees, including those irrigated with well water, did not survive the winter season.

8626 **(DOE/TIC—11382) Integrated plan for off-gas environmental control technology research and development in in-situ oil shale retorting.** (Mittelhauser Corp., Downers Grove, IL (USA)). 26 Jun 1979. Contract W-31-109-ENG-38. 72p. NTIS, PC A04/MF A01.

The following major observations were made in the study. The gas stream from modified in-situ (MIS) retorting of oil shale has a very low heating value, approximately 40 to 60 Btu/SCR. Sulfur appears in the gas primarily as H_2S, at a concentration of around 700 to 1400 ppMv, dry basis. The primary candidates for control of sulfur emissions from MIS retorting are direct liquid-phase oxidation ot elemental sulfur (the Stretford process), or combustion of the gas followed by flue gas desulfurization (FGD) to remove the sulfur oxides. Selective acid gas removal followed by Claus sulfur recovery does not appear to be a viable sulfur emission control process for MIS retorting, as it may be for some above-ground retorting processes. A better use of liquid acid gas removal solvents appears to be that of non-selective amines to remove both H_2S and CO_2 from the gas. The acid gas is sent through a Stretford unit smaller than would be required on the primary gas stream, and upgrades the heating value of the primary gas stream itself, raising the theoretical combustion temperature and reducing ancillary fuel requirements. An overall research plan for environmental aspects of in-situ retorting has been developed and is described in this report. Gas stream controls can be investigated as part of this plan. The specific sulfur control program proposed for OXY's proposed Retorts 7 and 8 at Logan Wash involves installation and testing of skid-mounted units on a slip-stream of retort gas. Units proposed are: (1) Stretford, (2) Incineration with SO_2 Scrubbing, (3) Non-selective Acid Gas Removal, (4) Molecular Sieves with upgraded particulate removal ahead of the sieves. Including EPA's furnishing of a skid-mounted SO_2 Scrubbing test unit, the preliminary estimated order-of-magnitude investment for this program is about $1.8 million, versus $3.0 million for a full-flow Stretford unit.

0410 Enviromental Aspects

8627 (DOE/EV—0128, pp 77-92) **Oil shale.** Jun 1980. In Division of Environmental Control Technology Program, 1979.

This section focuses on modified in situ retorting technologies of the oil shale industry. Studies have suggested that retort abandonment and control of pollutant migration is a major concern. Wastewater control and management studies were directed at the identification of technically feasible options. The technology needed to control leaching from raw and spent shale materials was studied. (KRM)

05 NUCLEAR FUELS

0502 Exploration

REFER ALSO TO CITATION(S) 8666, 9678

8628 **(GJBX—12(81)) Uranium hydrogeochemical and stream sediment reconnaissance data release for the Socorro NRMS Quadrangle, New Mexico, including concentrations of forty-two additional elements.** Planner, H.N.; Fuka, M.A.; Hanks, D.E.; Hansel, J.M.; Minor, M.M.; Montoya, J.D.; Sandoval, W.F. (Los Alamos Scientific Lab., NM (USA)). Oct 1980. Contract W-7405-ENG-36. 165p. (LA—8001-MS). NTIS, PC A08/MF A01.

Results for uranium in water samples and uranium and 42 additional elements in sediment samples are given. A total of 650

water samples was collected from wells (525), springs (99), streams (25), and one pond. Uranium concentrations for all water samples range from below the detection limit to 157.20 parts per billion (ppB). Mean concentrations in springs and well waters are 4.91 ppB and 5.04 ppB, respectively, compared to a value of 2.78 ppB in stream waters. Of the 1384 sediment samples collected, 1246 are from dry stream beds. The remaining 138 samples are from springs (68), ponds (50), and flowing streams (20). Uranium concentrations in sediments range from 0.84 to 13.40 parts per million (ppM) with the exception of a single 445.10-ppM concentration. The mean uranium content of all sediments is 3.12 ppM. Field data, recorded at the collection site, are reported with the elemental concentrations for each water and sediment sample listed in Appendixes I-A and I-B. These data include a scintillometer determination of the equivalent uranium, pH and conductivity measurements, and geographic and weather information. Appendix II explains the codes used in Appendix I and describes the standard field and analytical procedures used by the LASL in the HSSR program.

8629 **(GJBX—13(81)) Uranium hydrogeochemical and stream sediment reconnaissance data release for the Leadville NTMS Quadrangle, Colorado, including concentrations of forty-two additional elements.** Planner, H.N. (Los Alamos Scientific Lab., NM (USA)). Oct 1980. Contract W-7405-ENG-36. 105p. (LA—8013-MS). NTIS, PC A06/MF A01.

A total of 1797 locations was sampled over a 19 330-km^2 area, providing an average density of one sample location per 11 km^2. This report contains results for uranium in water samples and uranium and 42 additional elements in sediment samples. A total of 1279 water samples was collected from streams (1125) and springs (154). Uranium concentrations for all water samples range from below the detection limit of 0.02 ppB to 37.56 ppB. Mean concentrations in streams and springs are 1.05 ppB and 1.19 ppB, respectively. A total of 1784 sediment samples was collected from streams (1590), springs (193), and one pond. Uranium concentrations in sediments range from 1.27 to 223.80 ppM. Statistical mean uranium concentrations for wet stream (8.55 ppM) and spring (7.51 ppM) sediments are found to be greater than their dry counterparts (5.13 ppM and 4.96 ppM, respectively). Field data, recorded at the collection site, are reported with the elemental concentrations for each water and sediment sample listed. These data include a scintillometer determination of the equivalent uranium, pH and conductivity measurements, and geographic and weather information.

8630 **(GJBX—14(81)) Lewiston 1° x 2° NTMS area, Maine, New Hampshire, and Vermont. Data report (abbreviated).** Cook, J.R.; Koller, G.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Nov 1980. Contract AC09-76SR00001. 19p. (DPST—80-146-18). NTIS, PC E02/MF $3.50.

Includes 7 sheets of 24 reduction microfiche.

Surface sediment samples were collected at 1168 sites. Ground water samples were collected at 638 sites. Neutron activation analysis results are given for U and 16 other elements in sediments, and for U and 8 other elements in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented. Data from ground water sites include: water chemistry measurements (pH, conductivity, and alkalinity), physical measurements where applicable (water temperature, well description) and elemental analyses (U, Al, Br, Cl, Dy, F, Mn, Na, and V). Data from sediment sites include: stream water chemistry measurements, and element analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation) are given. Areal distribution maps, histograms, and cumulative frequency plots for most elements and for U/Th and U/Hf ratios are included. Key data from stream water sites include: water quality measurements and elemental analyses (U, Al, Br, Cl, Dy, F, Mg, Mn, Na, and V). The maximum uranium concentration in the sediments of the Lewiston quadrangle is 75 ppM. The highest concentrations occur in the southern part of the quadrangle in the White Mountain batholith and in the Sebago pluton. The areal distribution plot of log (U/Th) shows a cluster of high values in the north-central part of the area, apparently from sediments derived from the Mooselookmeguntic pluton. The highest concentration of uranium in ground water is 119.8 ppB. Two high concentrations occur side-by-side in the northeast corner of the quadrangle, and these high values persist in their U x 1000/conductivity ratios. The highest uranium concentration in stream water is 10.2 ppB. A group of high values was found in the north-central part of the quadrangle, similar in distribution to the log (U/Th) ratio in sediments.

8631 **(GJBX—15(81)) Providence 1° x 2° NTMS area, Connecticut, Massachusetts, and Rhode Island: data report (abbreviated).** Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Nov 1980. Contract AC09-76SR00001. 19p. (DPST—80-146-20). NTIS, PC E02/MF $3.50.

Includes 7 sheets of 24 reduction microfiche.

Results of ground water and stream sediment reconnaissance in the National Topographic Map Series (NTMS) Providence 1° x 2° quadrangle are presented. Surface sediment samples were collected at 318 sites. Ground water samples were collected at 180 sites. Neutron activation analysis (NAA) results are given for uranium and 16 other elements in sediments, and for uranium and 8 other elements in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Data from ground water sites include: water chemistry measurements (pH, conductivity, and alkalinity), physical measurements where applicable (water temperature, well description, etc.), and elemental analyses (U, Al, Br, Cl, Dy, F, Mn, Na, and V). Data from sediment sites include: stream water chemistry measurements (pH, conductivity, and alkalinity), and elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation, etc.) are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for most elements and for U/Th and U/Hf ratios are included on the microfiche. Key data from stream water sites include: water quality measurements (pH, conductivity, and alkalinity), and elemental analyses (U, Al, Br, Ci, Dy, F, Mg, Mn, Na, and V). Uranium concentrations in the sediments ranged from 1.2 to 61.7 ppM with an average of 4.5 ppM. A group of high uranium concentrations was found in Barnstable County, Massachusetts. These sites also had high concentrations of thorium and rare-earth elements that indicate the presence of a sand with a high proportion of heavy minerals.

8632 **(GJBX—16(81)) Rocky Mount and Manteo 1° x 2° NTMS areas, North Carolina. Data report (abbreviated).** Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Nov 1980. Contract AC09-76SR00001. 19p. (DPST—80-146-21). NTIS, PC E02/MF $3.50.

Includes 7 sheets of 24 reduction microfiche.

Surface sediment samples were collected at 501 sites. Ground water samples were collected at 851 sites. Neutron activation analysis results are given for uranium and 16 other elements in sediments, and for uranium and 8 other elements in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Data from ground water sites include: (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) physical measurements where applicable (water temperature, well description, etc.), and (3) elemental analyses (U, Al, Br, Cl, Dy, F, Mn, Na, and V). Data from sediment sites include: (1) stream water chemistry measurements (pH, conductivity, and alkalinity), and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation, etc.) are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for most elements and for U/Th and U/Hf ratios are included on the microfiche for the Rocky Mount quadrangle. Only one sediment and two ground water samples were collected in the Manteo quadrangle. Key data from stream water sites include: (1) water quality measurements (pH, conductivity, and alkalinity) and (2) elemental analyses (U, Al, Br, Cl, Dy, F, Mg, Mn, Na, and V). Uranium concentrations in the sediments of the Rocky Mount quadrangle range from a high of 46.4 ppM to a low of 0.90 ppM. A group of high uranium values are clustered in the northwest corner of this quadrangle. Some of these high concentrations persist in the U/Th areal distribution plot and may bear further investigation.

8633 **(GJBX—17(81)) Beaufort 1° x 2° NTMS area, North Carolina: data report (abbreviated).** Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Nov 1980. Contract AC09-76SR0001. 19p. (DPST—80-146-22). NTIS, PC E01/MF $3.50.

Includes 6 sheets of 24 reduction microfiche.

Results are presented of ground water and stream sediment reconnasissance in the National Topographic Map Series (NTMS) Beaufort 1° x 2° quadrangle. Surface sediment samples were collected at 188 sites. Ground water samples were collected at 305 sites. Neutron activation analysis results are given for uranium and 16 other elements in sediments, and for uranium and 8 other elements in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Data from ground water sites include: water chemistry measurements (pH, conductivity, and alkalinity), physical measurements where applicable (water temperature, well description, etc.), and elemental analyses (U, Al, Br, Cl, Dy, F, Mn, Na, and V). Data from sediment sites include: stream water chemistry measurements (pH, conductivity, and alkalinity), and elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation, etc.) are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for most elements and for U/Th and U/Hf ratios are included on the microfiche. Key data from stream water sites include: water quality measurements (pH, conductivity, and alkalinity), and elemental analyses (U, Al, Br, Cl, Dy, F, Mg, Mn, Na, and V). The highest uranium concentrations in the Beaufort 1° x 2° NTMS quadrangle occur in a cluster in the northwestern portion of this area. These sites also have high concentrations of thorium and rare-earth elements indicating the presence of resistate heavy minerals.

8634 **(GJBX—22(81)) Investigation of uranium potential of Precambrian metasedimentary rocks, central Laramie Range, Wyoming. Final report.** Graff, P.J.; Sears, J.W.; Holden, G.S. (Research Associates of Wyoming, Casper (USA)). Jan 1981. Contract AC13-76GJ01664. 163p. NTIS, PC A08/MF A01.

This study is directed toward evaluation of potential uraniferous quartz-pebble conglomerate occurrences or strata-bound uranium occurrences in the Laramie Range. Geologic investigations pursuant to that evaluation provide that metasediments in the central Laramie Range constitute an Archean greenstone belt which overlies remobilized granite-gneiss basement terrane of the Archean Wyoming Province. This greenstone belt is formed of branching arcuate, synformal keels of supracrustal rocks infolded and enveloped by granitic domes. The stratigraphic succession of the belt is a triad formed of lower mafic-ultramafic rocks including komatiites, middle mafic volcanics including pillow basalts, and an upper metasedimentary sequence composed of boulder paraconglomerates, graywackes, marbles, quartzites, pelites, thin quartz-pebble conglomerates and thin, banded iron formation. Because the metasedimentary sequence does not contain a thick, mature clastic wedge, a thick fluvial section, basal quartz-pebble conglomerates, or significant geochemical or radiometric anomalies and because the sequence is structurally complex and regionally of amphibolite facies metamorphic rank, the potential for uraniferous fossil placers is considered nil. Occurrences of other types may be indicated by radiometric and geochemical anomalies discovered over sheared zones within the granite-gneiss terrane and small radiometric anomalies over a coarse-grained phase of granite located north of the greenstone belt.

8635 **(SAND—80-1410) Development of interpretation models for PFN uranium log analysis.** Barnard, R.W. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 50p. NTIS, PC A03/MF A01.

This report presents the models for interpretation of borehole logs for the PFN (Prompt Fission Neutron) uranium logging system. Two models have been developed, the counts-ratio model and the counts/dieaway model. Both are empirically developed, but can be related to the theoretical bases for PFN analysis. The models try to correct for the effects of external factors (such as probe or formation parameters) in the calculation of uranium grade. The theoretical bases and calculational techniques for estimating uranium concentration from raw PFN data and other parameters are discussed. Examples and discussions of borehole logs are included.

8636 **(GJBX—20(80)(Vol.1)) Airborne gamma-ray spectrometer and magnetometer survey: San Luis Obispo (California), Santa Maria (California). Final report.** (High Life Helicopters, Inc., Puyallup, WA (USA); QEB, Inc., Lakewood, CO (USA)). [nd]. Contract AC13-79GJ01692. 78p. NTIS, PCE 10/MF $15.95.

Report contains 92 fiche reduction factor 48X.

An airborne combined radiometric and magnetic survey was performed over the area covered by the Santa Maria and San Luis Obispo, California 1:250,000 National Topographic Map Series (NTMS) 1° x 2° quadrangle maps. The survey was a part of DOE's National Aerial Radiometric Reconnaissance program, which is in turn a part of the National Uranium Resource Evaluation (NURE) program. Data were collected by a helicopter equipped with a gamma-ray spectrometer having a large crystal volume, and a high sensitivity proton precession magnetometer. The radiometric system was calibrated at the Walker Field Calibration pads and the Lake Mead Dynamic Test range. Data quality was ensured throughout the survey by daily test flights and equipment checks. Radiometric data were corrected for live time, aircraft and equipment background, cosmic background, atmospheric radon, Compton scatter, and altitude dependence. The corrected data were statistically evaluated, plotted and contoured to produce anomaly maps based on the radiometric response of individual geological units. These maps were interpreted and an anomaly interpretation map produced. Volume I contains a description of the systems used in the survey, a discussion of the calibration of the systems, the data processing procedures, the data display format, the interpretation rationale, and the interpretation methodology. A separate Volume II for each quadrangle contains the data displays and the interpretation results.

0505 Enrichment

REFER ALSO TO CITATION(S) 8685

8637 **Laser isotope separation.** Jensen, R.J.; Sullivan, J.A.; Finch, F.T. (Los Alamos Scientific Lab., NM). *Separation Science and Technology (U.S.);* **15**: No. 3, 509-532(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

A brief background on the history and motivation of laser isotope separation is presented. Methods of molecular laser isotope separation are reviewed, and the Los Alamos process for separation of uranium isotopes as well as the general problems with this approach are covered. A short summary on critical uv cross-section-enhancement results is given and the implications of infrared cross-section dependence on laser fluence is discussed. The laser requirements for the LASL process and the projected economics for this process are presented. The future prospects for molecular laser isotope separation as well as some speculation on general advances in photochemistry are presented.

0507 Fuels Production And Properties

8638 **(LA—8661-MS) HTGR green rod intercomparison. I. Hydrogen assay.** Meier, M.M.; Adams, E.L. (Los Alamos Scientific Lab., NM (USA)). Jan 1981. Contract W-7405-ENG-36. 14p. NTIS, PC A02/MF A01.

A ^{252}Cf hydrogen monitor has been used to determine the hydrogen content of each of the 144 unfired (green) fuel rods being circulated in the New Brunswick Laboratory fuel measurement evaluation program. The monitor was calibrated with standards fabricated by Los Alamos Scientific Laboratory (LASL) Analytical Chemistry Group, CMB-1. Measurements were made relative to these standards and overall accuracies of +-3% were achieved.

8639 **Detection of gas-permeable fuel particles for high temperature gas-cooled reactors.** Thiele, B.A.; Stinton, D.P.; Costanzo, D.A. (Oak Ridge National Lab., TN (USA)). *Carbon (England);* **18**: No. 2, 125-129(1980).

Fuel for High-Temperature Gas-Cooled Reactors (HTGR) consists of uranium oxide-carbide and thoria microspheres coated with layers of pyrolytic carbon and silicon carbide. The pyrolytic carbon coatings must be gas-tight to perform properly during irradiation. Therefore, particles must be carefully characterized to determine the number of defective particles (ie bare kernels, and cracked or permeable coatings). Although techniques are available to determine the number of bare kernels or cracked coatings, no reliable technique has been available to measure coating permeability. This work describes a technique recently developed to determine whether coatings for a batch of particles are gas-tight or permeable. Although most of this study was performed on Biso-coated particles, the technique applies equally well to Triso-coated particles. About 150 randomly selected Biso-particle batches were studied in this work. These batches were first subjected to an 18h chlorination at 15000°C, and the volatile thorium tetrachloride released through cracked or very permeable coatings was measured versus chlorination time. Chlorinated batches were also radiographed to detect any thorium that had migrated from the kernel into the coatings. From this work a technique was developed to determine coating permeability. This consists of an 18h chlorination of multiple samples without measurement of the heavy metal released. Each batch is then radiographed and the heavy metal diffusion within each particle is examined so it can be determined if a particle batch is permeable, slightly permeable, or gas-tight.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 8655, 8687

8640 **(AGNS—35900-1.2-104) Spent fuel disassembly and canning programs at the Barnwell Nuclear Fuel Plant (BNFP).** Townes III, G.A. (Allied-General Nuclear Services, Barnwell, SC (USA)). Oct 1980. Contract AC09-78ET35900. 77p. NTIS, PC A04/MF A01.

Methods of disassembling and canning spent fuel to allow more efficient storage are being investigated at the BNFP. Studies and development programs are aimed at dry disassembly of fuel to allow storage and shipment of fuel pins rather than complete fuel assemblies. Results indicate that doubling existing storage capacity or tripling the carrying capacity of existing transportation equipment is achievable. Disassembly could be performed in the BNFP hot cells at rates of about 12 to 15 assemblies per day.

8641 **(DPST-CFRP—80-113) Component failure-rate data with potential applicability to the hot experimental facility. Technical information.** Dexter, A.H. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Dec 1980. Contract AC09-76SR00001. 39p. NTIS, PC A03/MF A01.

A literature search, that was aided by computer searches of a number of data bases, resulted in the compilation of approximately 1223 pieces of component failure-rate data under 136 subject categories. The data bank can be provided upon request as a punched-card deck or on magnetic tape.

0509 Transport And Storage

8642 **(DOE/SR—0006) Department of Energy report on fee for spent nuclear fuel storage and disposal services.** (Department of Energy, Washington, DC (USA)). Oct 1980. 19p. NTIS, PC A02/MF A01.

Since the July 1978 publication of an estimated fee for storage and disposal, several changes have occurred in the parameters which impact the spent fuel fee. DOE has mounted a diversified program of geologic investigations that will include locating and characterizing a number of potential repository sites in a variety of different geologic environments with diverse rock types. As a result, the earliest operation date of a geologic repository is now forecast for 1997. Finally, expanded spent fuel storage capabilities at reactors have reduced the projected quantities of fuel to be stored and disposed of. The current estimates for storage and disposal are presented. This fee has been developed from DOE program information on spent fuel storage requirements, facility availability, facility cost estimates, and research and development programs. The discounted cash flow technique has used the most recent estimates of cost of borrowing by the Federal Government. This estimate has also been used in calculating the Federal charge for uranium enrichment services. A prepayment of a percentage of the storage portion of the fee is assumed to be required 5 years before spent fuel delivery. These funds and the anticipated $300 million in US Treasury borrowing authority should be sufficient to finance the acquisition of storage facilities. Similarly, a prepayment of a percentage of the disposal portion would be collected at the same time and would be used to offset disposal research and development expenditures. The balance of the storage and disposal fees will be collected upon spent fuel delivery. If disposal costs are different from what was estimated, there will be a final adjustment of the disposal portion of the fee when the spent fuel is shipped from the AFR for permanent disposal. Based on current spent fuel storage requirements, at least a 30 percent prepayment of the fee will be required.

8643 **(PNL—3367) HYDRA-I: a three-dimensional finite difference code for calculating the thermohydraulic performance of a fuel assembly contained within a canister.** McCann, R.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1980. Contract AC06-76RL01830. 108p. NTIS, PC A06/MF A01.

A finite difference computer code, named HYDRA-I, has been developed to simulate the three-dimensional performance of a spent fuel assembly contained within a cylindrical canister. The code accounts for the coupled heat transfer modes of conduction, convection, and radiation and permits spatially varying boundary conditions, thermophysical properties, and power generation rates. This document is intended as a manual for potential users of HYDRA-I. A brief discussion of the governing equations, the solution technique, and a detailed description of how to set up and execute a problem are presented. HYDRA-I is designed for operation on a CDC 7600 computer. An appendix is included that summarizes approximately two dozen different cases that have been examined. The cases encompass variations in fuel assembly and canister configurations, power generation rates, filler materials, and gases. The results presented show maximum and various local temperatures and heat fluxes illustrating the changing importance of the three heat transfer modes. Finally, the need for comparison with experimental data is emphasized as an aid in code verification although the limited data available indicate excellent agreement.

8644 **(RHO-BWI-SA—42) Oregon-based activities in support of the Basalt Waste Isolation Project.** Wilkinson, L.E. (Foundation Sciences, Inc., Portland, OR (USA)). Jan 1980. Contract AC06-77RL01030. 22p. (CONF-800153—1). NTIS, PC A02/MF A01.

From Meeting of the Oregon section American Nuclear Society; Salem, OR, USA (16 Jan 1980).

Rockwell Hanford Operations (Rockwell) is the prime operating contractor responsible for the Basalt Waste Isolation Project (BWIP) at Hanford and has been charged with conducting associated engineering and scientific investigations. The investigations will assess the feasibility of utilizing basalt for nuclear waste storage. As recently noted in a report by the Interagency Review Group to the President in October 1978, Once feasibility is established at various sites, DOE will decide which site is selected for construction of a repository. A portion of the Rockwell program is the design construction and testing of basalts in a near-surface test facility (NSTF) within the Hanford Site. The NSTF is a facility for examination of the behavior of an entire basalt mass. It is composed of rooms embedded in the central portion of a basalt flow. In situ tests will include experiments with electric heaters, followed by experiments with spent fuel where the combined effect of heat and radiation will be examined. Approximately 3000 feet of tunnels and test room area are being constructed in Gable Mountain on the Hanford Site.

8645 **(SAND—80-1804C) RADTRAN II: a computerized model for risk analysis of transportation of radioactive material.** Taylor, J.M.; Daniel, S.L.; Biringer, B.E. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 14p. (CONF-801115—39). NTIS, PC A02/MF A01.

From 6. international symposium on packaging and transporting radioactive material; Berlin, F.R. Germany (10 Nov 1980).

The RADTRAN computer code, which formed the basis for the 1977 US generic transportation risk assessment, has been extensively updated. The updated version of the code, denoted RADTRAN II, includes changes based on findings from other transportation risk studies as well as changes based on reevaluation of earlier assumptions, analyses, and computerization techniques. The environmental impact of the transportation of radioactive material can be envisioned as consisting of five components, incident free transport, non-radiological impacts, vehicular accidents, breaches of security/safeguards, and failures of quality assurance. RADTRAN II is designed to evaluate both the incident-free and the accident contribution directly and can be used to evaluate the contributions of breaches of security and quality assurances deviation if some alterations in coding are made. Non-radiological impacts are not addressed.

8646 **(SAND—80-1885) Transportation Technical Environmental Information Center index.** Davidson, C.A.; Foley, J.T. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1980. Contract AC04-76DP00789. 54p. NTIS, PC A04/MF A01.

In an effort to determine the environmental intensities to which energy materials in transit may be exposed, a Data Center of technical environmental information has been established by Sandia National Laboratories, Division 5523, for the DOE Office of Transportation Fuel Storage. This document is an index which can be used to request data of interest. Access to the information held is not limited to Sandia personnel. The purpose of the Transportation Technical Environmental Information Center is to collect, analyze, store, and make available descriptions of the environment of transportation expressed in engineering terms. The data stored in the Center are expected to be useful in a variety of transportation related analyses. Formulations of environmental criteria for shipment of cargo, risk assessments, and detailed structural analyses of shipping containers are examples where these data have been applied. For purposes of indexing and data retrieval, the data are catalogued under two major headings: Normal and Abnormal Environments.

8647 **(UCRL—52985) Mechanical and thermomechanical calculations related to the storage of spent nuclear-fuel assemblies in granite.** Butkovich, T.R. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). May 1980. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01.

A generic test of the geologic storage of spent-fuel assemblies is being made at Nevada Test Site. The spent-fuel assemblies were emplaced at a depth of 420 m (1370 ft) below the surface in a typical granite and will be retrieved at a later time. The early time, close-in thermal history of this type of repository is being simulated with spent-fuel and electrically heated canisters in a central drift, with auxiliary heaters in two parallel side drifts. Prior to emplacement of the spent-fuel canisters, preliminary calculations were made using a pair of existing finite-element codes, ADINA and ADINAT.

0510 Marketing And Economics

REFER ALSO TO CITATION(S) 8642

0520 Waste Management

REFER ALSO TO CITATION(S) 8560, 8642, 8644, 8647, 8677, 8678, 8679, 8680, 9525, 9642, 9655, 9659, 9660, 9662, 9766, 9767, 9772, 9773, 9774, 9775, 9776, 9777, 9778, 9779, 9780, 9781, 9782

8648 **(CONF-801107—61) Managing low-level radioactive wastes: a proposed approach.** Peel, J.W.; Levin, G.B. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 23p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

In 1978, President Carter established the Interagency Review Group on Nuclear Waste Management (IRG) to review the nation's plans and progress in managing radioactive wastes. In its final report, issued in March 1979, the group recommended that the Department of Energy (DOE) assume responsibility for developing a national plan for the management of low-level wastes. Toward this end, DOE directed that a strategy be developed to guide federal and state officials in resolving issues critical to the safe management of low-level wastes. EG and G Idaho, Inc. was selected as the lead contractor for the Low-Level Waste Management Program and was given responsibility for developing the strategy. A 25 member task force was formed which included individuals from federal agencies, states, industry, universities, and public interest groups. The task force identified nineteen broad issues covering the generation, treatment, packaging, transportation, and disposal of low-level wastes. Alternatives for the resolution of each issue were proposed and recommendations were made which, taken together, form the draft strategy. These recommendations are summarized in this document.

8649 **(DOE/EV—0128, pp 109-133) Nuclear energy.** Jun 1980.

In Division of Environmental Control Technology Program, 1979.

This section focuses on: the assessment of the environmental control aspects of alternative nuclear fuel cycles; continuation of the assessment of alternate waste management concepts, including investigation of the environmental and technical feasibility of high-level waste disposal into deep ocean sediments; and development of methods for assessing the adequacy of the environmental protection and public safety afforded by Department of Energy nuclear energy material shipping container systems.

8650 **(DP—80-125-2) Waste management program. Technical progress report, April-June 1980.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Dec 1980. Contract AC09-76SR00001. 170p. NTIS, PC A08/MF A01.

This quarterly report provides current information on operations and development programs for the management of radioactive wastes from operation of the Savannah River Plant. The studies on environmental and safety assessments, waste form development and characterization, process and equipment development, on-site storage and disposal, the Defense Waste Processing Facility, TRU waste, and low-level waste R & D are reported in the Long-Term Waste Management Technology Program. The following studies are reported for the Interim Waste Operations Program: surveillance and maintenance, waste concentration, low-level effluent waste, waste tank evaluation, tank replacement/waste transfer, and solid waste storage. The development of criteria for the selection of sites for storage of waste forms produced in the Defense Waste Processing Facility is described in the Commercial Waste Program.

8651 **(DP-MS—80-93) Borosilicate glass as a matrix for immobilization of SRP high-level waste.** Wicks, G.G. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 20p. NTIS, PC A02/MF A01.

Approximately 22 million gallons of high-level radioactive defense waste are currently being stored in large underground tanks located on the Savannah River Plant (SRP) site in Aiken, South Carolina. One option now being considered for long-term management of this waste involves removing the waste from the tanks, chemically processing the waste, and immobilizing the potentially harmful radionuclides in the waste into a borosilicate glass matrix. The technology for producing waste glass forms is well developed and has been demonstrated on various scales using simulated as well as radioactive SRP waste. Recently, full-scale prototypical equipment has been made operational at SRP. This includes both a joule-heated ceramic melter and an in-can melter. These melters are a part of an integrated vitrification system which is under evaluation and includes a spray calciner, direct liquid feed apparatus, and various elements of an off-gas system. Two of the most important properties of the waste glass are mechanical integrity and leachability. Programs are in progress at SRL aimed at minimizing thermally induced cracking by carefully controlling cooling cycles and using ceramic liners or coatings. The leachability of SRP waste glass has been studied under many different conditions and consistently found to be low. For example, the leachability of actual SRP

waste glass was found to be 10^{-6} to 10^{-5} g/(cm²)(day) initially and decreasing to 10^{-9} to 10^{-8} g/(cm²)(day) after 100 days. Waste glass is also being studied under anticipated storage conditions. In brine at 90°C, the leachability is about 5 x 10^{-8} g/(cm²)(day) after 60 days. The effects of other geological media including granite, basalt, shale, and tuff are also being studied as part of the multibarrier isolation system.

8652 **(EPRI-AP—1644) Background study of liner fusion systems for transmuting fission reactor wastes. Final report.** Schaffer, M.J.; Parish, T.A. (General Atomic Co., San Diego, CA (USA); Texas Univ., Austin (USA). Nuclear Reactor Lab.). Dec 1980. 287p. NTIS, PC A13/MF A01.

Liner fusion systems were studied in order to evaluate their potential for the transmutation of selected fission wastes. The transmutation goals selected allow one generation (50 y) to reduce the radiological hazard to the order of the natural ore from which it was produced. Two plasma configurations were considered: a field-reversed theta-pinch and an open field-line wall-confined linear plasma. Only thick liquid waste-containing liners were considered. Numerous contributions to liner, plasma and reactor physics and engineering are reported. Average liner surface loadings up to several hundred MW/m² are predicted, which yield hazard depletion e-folding times suitable for actinide, strontium and cesium wastes. The most critical and difficult unsolved technical questions are (1) processing waste with only a few hundred ppM total leakage of actinide and strontium and (2) ^{90}Sr isotope separation.

8653 **(MLM—2788) Defense waste cyclone incinerator demonstration program: April-September 1980.** Klingler, L.M. (Mound Facility, Miamisburg, OH (USA)). 16 Jan 1981. Contract AC04-76DP00053. 11p. NTIS, PC A02/MF A01.

An improved offgas system is being designed. The new system will improve gas cleaning and will also provide for improved offgas sampling and mass balance data collection. Continuous solid feed burning experiments were delayed pending delivery of shredding equipment. Liquid burning experiments were in progress at fiscal year end. Burn data indicate that the incinerator will work well for combustible liquids. Improved data on incinerator performance will be generated upon completion of system changes and utilization of new sampling and analysis equipment. Mound Facility received advanced guidance from the Transuranic Waste Systems Office that this program will be cancelled in FY-1981 because of reductions in funding levels.

8654 **(MLM—2795) Development of ultrafiltration and adsorbents: April-September 1980.** Williams, M.K.; Colvin, C.M. (Mound Facility, Miamisburg, OH (USA)). 23 Jan 1981. Contract AC04-76DP00053. 26p. NTIS, PC A03/MF A01.

Reverse osmosis, on a pilot-plant scale, was successful in removing large percentages of actinide isotopes from low-level aqueous streams. The relative effectiveness of three membrane types, 0, 50 and 97% salt rejection, in actinide removal was explored. The 97% salt rejection membrane was the most effective, generally removing in excess of 98% of the actinides. A main-effects-design experiment was performed to assess which of seven variables had a significant effect on the adsorption of cesium-137 by three strongly acidic, cationic ion exchange resins. Sodium, potassium, calcium, and cesium-133 concentrations were found to significantly affect the adsorption of two of the resins, and calcium, potassium, and cesium-137 concentrations significantly affected the third resin.

8655 **(ORNL/TM—7338) Processes for the control of $^{14}CO_2$ during reprocessing.** Notz, K.J.; Holladay, D.W.; Forsberg, C.W.; Haag, G.L. (Oak Ridge National Lab., TN (USA)). Jul 1980. Contract W-7405-ENG-26. 30p. NTIS, PC A03/MF A01.

The fixation of $^{14}CO_2$ may be required at some future time because of the significant fractional contribution of ^{14}C, via the ingestion pathway, to the total population dose from the nuclear fuel cycle, even though the actual quantity of this dose is very small when compared to natural background. The work described here was done in support of fuel reprocessing development of both graphite fuel (HTGRs) and metal-clad fuel (LWRs and LMFBRs), and was directed to the control of $^{14}CO_2$ released during reprocessing operations. However, portions of this work are also applicable to the control of $^{14}CO_2$ released during reactor operation. The work described falls in three major areas: (1) the application of liquid-slurry fixation with $Ca(OH)_2$, which converts the CO_2 to $CaCO_3$, carried out after treatment of the CO_2-containing stream to remove other gaseous radioactive components, mainly ^{85}Kr. This approach is primarily for application to HTGR fuel reprocessing; (2) the above process for CO_2 fixation, but used ahead of krypton removal, and followed by a molecular sieve process to take out the ^{85}Kr. This approach was developed for use with HTGR reprocessing, but certain aspects also have application to metal-clad fuel reprocessing and to reactor operation; (3) the use of solid $Ba(OH)_2$ hydrate, reacting directly with the gaseous phase. This process is generally applicable to both reprocessing and reactor operation.

8656 **(ORNL/TM—7501) Effects of slag composition and process variables on decontamination of metallic wastes by melt refining.** Heshmatpour, B.; Copeland, G.L. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 35p. NTIS, PC A03/MF A01.

Melt refining has been suggested as an alternative for decontamination and volume reduction of low-level-contaminated metallic wastes. Knowledge of metallurgical and thermochemical aspects of the process is essential for effective treatment of various metals. Variables such as slag type and composition, melting technique, and refractory materials need to be identified for each metal or alloy. Samples of contaminated metals were melted with fluxes by resistance furnace or induction heating. The resulting ingots as well as the slags were analyzed for their nuclide contents, and the corresponding partition ratios were calculated. Compatibility of slags and refractories was also investigated, and proper refractory materials were identified. Resistance furnace melting appeared to be a better melting technique for nonferrous scrap, while induction melting was more suitable for ferrous metals. In general uranium contents of the metals, except for aluminum, could be reduced to as low as 0.01 to 0.1 ppM by melt refining. Aluminum could be decontaminated to about 1 to 2 ppM U when certain fluoride slags were used. The extent of decontamination was not very sensitive to slag type and composition. However, borosilicate and basic oxidizing slags were more effective on ferrous metals and Cu; $NaNO_3$-NaCl-NaOH type fluxes were desirable for Zn, Pb, and Sn; and fluoride type slags were effective for decontamination of Al. Recrystallized alumina proved to be the most compatible refractory for melt refining both ferrous and nonferrous metals, while graphite was suitable for nonferrous metal processing. In conclusion, melt refining is an effective technique for volume reduction ad decontamination of contaminated metal scrap when proper slags, melting technique, and refractories are used.

8657 **(PNL—3000-7) Nuclear waste management. Quarterly progress report, July-September 1980.** Chikalla, T.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1980. Contract AC06-76RL01830. 134p. NTIS, PC A07/MF A01.

Research is reported on: high-level waste immobilization, alternative waste forms, TRU waste immobilization and decontamination, krypton solidification, thermal outgassing, ^{129}I fixation, unsaturated zone transport, well-logging instrumentation, waste management system and safety studies, effectiveness of geologic isolation systems, waste/rock interactions, engineered barriers, backfill material, spent fuel storage (criticality), barrier sealing and liners for U mill tailings, and revegetation of inactive U tailings sites. (DLC)

8658 **(PNL—3336) Vibratory finishing as a decontamination process.** McCoy, M.W.; Arrowsmith, H.W.; Allen, R.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1980. Contract AC06-76RL01830. 52p. NTIS, PC A04/MF A01.

The major objective of this research is to develop vibratory finishing into a large-scale decontamination technique that can economicaly remove transuranic and other surface contamination from large volumes of waste produced by the operation and decommissioning of retired nuclear facilities. The successful development and widespread application of this decontamination technique would substantially reduce the volume of waste requiring expensive

geologic disposal. Other benefits include exposure reduction for decontamination personnel and reduced risk of environmental contamination. Laboratory-scale studies showed that vibratory finishing can rapidly reduce the contamination level of transuranic-contaminated stainless steel and Plexiglas to well below the 10-nCi/g limit. The capability of vibratory finishing as a decontamination process was demonstrated on a large scale. The first decontamination demonstration was conducted at the Hanford N-Reactor, where a vibratory finisher was installed to reduce personnel exposure during the summer outage. Items decontaminated included fuel spacers, process-tube end caps, process-tube inserts, pump parts, ball-channel inspection tools and miscellaneous hand tools. A second demonstration is currently being conducted in the decontamination facility at the Hanford 231-Z Building. During this demonstration, transuranic-contaminated material from decommissioned plutonium facilities is being decontaminated to <10 nCi/g to minimize the volume of material that will require geologic disposal. Items that are being decontaminated include entire glove boxes, process-hood structural material and panels, process tanks, process-tank shields, pumps, valves and hand tools used during the decommissioning work.

8659 **(PNL—3447) Use of ceramic materials in waste-package systems for geologic disposal of nuclear wastes.** Fullam, H.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1980. Contract AC06-76RL01830. 81p. NTIS, PC A05/MF A01.

A study to investigate the potential use of ceramic materials as components in the waste package systems was conducted. The initial objective of the study was to screen and compare a large number of ceramic materials and identify the best materials for the proposed application. The principal method used to screen the candidates was to subject samples of each material to a series of leaching tests and to determine their relative resistance to attack by the leach solutions. A total of 14 ceramic materials, plus graphite and basalt were evaluated using three different leach solutions: demineralized water, a synthetic Hanford ground water, and a synthetic WIPP brine solution. The ceramic materials screened were Al_2O_3 (99%), Al_2O_3 (99.8%), mullite ($2Al_2O_3.SiO_2$), vitreous silica (SiO_2), $BaTiO_3$, $CaTiO_3$, $CaTiSiO_5$, TiO_2, ZrO_2, $ZrSiO_4$, Pyroceram 9617, and Marcor Code 9658 machinable glass-ceramic. Average leach rates for the materials tested were determined from analyses of the leach solutions and/or sample weight loss measurements. Because of the limited scope of the present study, evaluation of the specimens was limited to ceramographic examination. Based on an overall evaluation of the leach rate data, five of the materials tested, namely graphite, TiO_2, ZrO_2, and the two grades of alumina, exhibited much greater resistance to leaching than did the other materials tested. Based on all the experimental data obtained, and considering other factors such as cost, availability, fabrication technology, and mechanical and physical properties, graphite and alumina are the preferred candidates for the barrier application. The secondary choices are TiO_2 and ZrO_2.

8660 **(PNL—3465) Annual report on the development and characterization of solidified forms for nuclear wastes, 1979.** Chick, L.A.; McVay, G.L.; Mellinger, G.B.; Roberts, F.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1980. Contract AC06-76RL01830. 90p. NTIS, PC A05/MF A01.

Development and characterization of solidified nuclear waste forms is a major continuing effort at Pacific Northwest Laboratory. Contributions from seven programs directed at understanding chemical composition, process conditions, and long-term behaviors of various nuclear waste forms are included in this report. The major findings of the report are included in extended figure captions that can be read as brief technical summaries of the research, with additional information included in a traditional narrative format. Waste form development proceeded on crystalline and glass materials for high-level and transuranic (TRU) wastes. Leaching studies emphasized new areas of research aimed at more basic understanding of waste form/aqueous solution interactions. Phase behavior and thermal effects research included studies on crystal phases in defense and TRU waste glasses and on liquid-liquid phase separation in borosilicate waste glasses. Radiation damage effects in crystals and glasses from alpha decay and from transmutation are reported.

8661 **(PNL—3617) Solid state storage of radioactive krypton in a silica matrix.** Tingey, G.L.; Lytle, J.M.; Gray, W.J.; Wheeler, K.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1980. Contract AC06-76RL01830. 25p. NTIS, PC A02/MF A01.

The feasibility of loading a low density SiO_2 glass with krypton for storage of radioactive ^{85}Kr has been demonstrated by studies using non-radioactive krypton. A 96% SiO_2 glass with 28% porosity was heated at an elevated pressure of Kr gas to a temperature of 850 to 900°C and held at that temperature to sinter the glass-krypton composite to a density of about 2 g/cm^3. A krypton content of 30 cm^3 of Kr(STP)/cm^3 of glass has been demonstrated when loading pressures of 140 MPa are used. Krypton release rates from the glass are lower than reported for any other waste form considered currently. At 420°C a diffusion parameter, D/r_0^2, of 8.66×10^{-13} min^{-1} was determined which leads to a total release of 0.7% of the krypton in 10 years. Release rates increase moderately with increasing temperature up to 600°C and increase rapidly above 600°C. The lower loading pressures (about 40 MPa) may appear to yield a more favorable product from the point of view of krypton release than the high pressures. Advantages and disadvantages of the technique are given in the conclusions section.

8662 **(PNL-SA—8267) Estimates of amounts of soil removal for clean-up of transuranics at NAEG offsite safety-shot sites.** Kinnison, R.R.; Gilbert, R.O. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract AC06-76RL01830. 8p. (CONF-800157—1). NTIS, PC A02/MF A01.

From Nevada applied ecology group (NAEG) information meeting; Las Vegas, NV, USA (29 Jan 1980).

Rough estimates are given for the amount of soil removal necessary to decontaminate five representative safety-shot areas. In order to decontaminate to levels of less than 160 pCi ^{239}Pu per gram of surface soil, it is estimated that over one-half million tons of soil would have to be removed from the five areas. This is a preliminary estimate based on summary data and concentration contour maps readily available in NAEG publications. More accurate estimates could be obtained by applying Kriging techniques to available soil data if the need arises. The inclusion of ^{241}Am and ^{238}Pu activities do not significantly increase the soil tonnage estimates obtained for $^{239,240}Pu$ because of their relatively small contributions to total transuranic activity. The magnitude of the errors inherent in our use of summary data to obtain rough estimates also suggests that a revision of the tonnage estimates for $^{239,240}Pu$ to include ^{241}Am and ^{238}Pu is not warranted.

8663 **(PNL-SA—8491) Incentives for partitioning, revisited.** Cloninger, M.O. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 24 Mar 1980. Contract AC06-76RL01830. 30p. (CONF-800444—2). NTIS, PC A03/MF A01.

From 2. technical meeting on the nuclear transmutation of actinides; Ispra, Italy (21 Apr 1980).

The incentives for separating and eliminating various elements from radioactive waste prior to final geologic disposal were investigated. Exposure pathways to humans were defined, and potential radiation doses to an individual living within the region of influence of the underground storage site were calculated. The assumed radionuclide source was 1/5 of the accumulated high-level waste from the US nuclear power economy through the year 2000. The repository containing the waste was assumed to be located in a reference salt site geology. The study required numerous assumptions concerning the transport of radioactivity from the geologic storage site to man. The assumptions used maximized the estimated potential radiation doses, particularly in the case of the intrusion water well scenario, where hydrologic flow field dispersion effects were ignored. Thus, incentives for removing elements from the waste tended to be maximized. Incentives were also maximized by assuming that elements removed from the waste could be eliminated from the earth without risk. The results of the study indicate that for reasonable disposal conditions, incentives for partitioning any elements from the waste in order to minimize the risk to humans are marginal at best.

8664 **(RHO-BWI-SA—82) Coupled geomechanical/hydrological modeling: an overview of basalt waste isolation project studies.** Baca, R.G.; Case, J.B.; Patricio, J.G. (Rockwell International Corp., Richland, WA (USA). Energy Systems Group). Jul 1980. Contract AC06-77RL01830. 30p. (CONF-800751—4). NTIS, PC A03/MF A01.

From Workshop on thermomechanical-hydrochemical modeling for hardrock waste repository; Bereley, CA, USA (29 Jul 1980).

Basalt Waste Isolation Project investigations of the Columbia River basalts are multi-disciplinary in nature with a broad scope spanning such areas as geology, seismology, geochemistry, hydrology, rock mechanics, and many other disciplines as well. In this paper, an overview is presented which surveys recent work on numerical modeling of geomechanical and hydrological processes in a basalt rock environment. A major objective of the ongoing numerical modeling work is to establish a predictive technology base with which to: interpret the interrelationships between geomechanical behavior of rock media, the natural hydrologic phenomena, and repository conditions; evaluate the effectiveness of preconceptual repository designs and assist in the design of in situ field testing; and assess the waste isolation capability of candidate host rocks within the Columbia River basalts. To accomplish this objective, a systems approach has been adopted which is based on the use of digital simulation models.

8665 **(RHO-BWI-SA—83) Radionuclide release scenario selection process for a possible repository in basalt.** Arnett, R.C.; Baca, R.G.; Caggiano, J.A.; Carrell, D.J.; Logan, S.E. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations; Los Alamos Scientific Lab., NM (USA)). Sep 1980. Contract AC06-77RL01030. 16p. (CONF-8009121—1). NTIS, PC A02/MF A01.

From International workshop on radionuclide scenarios for geologic repositories; Paris, France (8 Sep 1980).

As part of the US National Waste Terminal Storage Program, the Basalt Waste Isolation Project (BWIP) is aimed at assessing the feasibility of constructing a nuclear waste repository in a flow of the Columbia River Basalt Group located in the northwestern United States. Rockwell Hanford Operations is conducting the BWIP under contract to the US Department of Energy. This paper briefly considers some of the experience and results of early efforts within BWIP to develop a meaningful set of radionuclide release scenarios. The following topics are covered: generic release-inducing phenomena; setting and characteristics of the Columbia River basalt; scenario selection criteria; peliminary scenario elimination; credible release scenario selection; and scenarios examined to date, which are interconnecting fault, magmatic dike or sill intrusion, shaft seal failure, borehole intrusion, and fracturing due to microearthquake swarms.

8666 **(RHO-BWI-ST—4) Geologic studies of the Columbia Plateau: a status report.** Myers, C.W.; Price, S.M. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Oct 1979. Contract AC06-76RL01830. 13196p. A00 $65.50 ($15.50 text, $50.00 charts).

The results of recent geologic studies of the Columbia Plateau, with emphasis on work completed under the Basalt Waste Isolation Project, Rockwell Hanford Operations, are summarized in this report. Geologic studies were performed mostly during the period from 1977 to 1979. The major objective of these studies was to examine the feasibility of using deep underground tunnels mined into Columbia River basalt beneath the Hanford Site for final storage of nuclear waste. The results are presented in four chapters: Introduction; Regional Geology; Pasco Basin Geology; and Seismicity and Tectonics. Results from surface mapping and remote sensing studies in the Washington State portion of the Columbia Plateau are presented in the Regional Geology chapter. Results from surface mapping, borehole studies, and geophysical surveys in the Pasco Basin are presented in the Pasco Basin Geology chapter. Results that relate to the tectonic stability of the Pasco Basin and Columbia Plateau and discussion of findings from earthquake monitoring in the region for the past ten years are summarized in the Seismicity and Tectonics chapter. A volume of Appendices is included. This volume contains a description of study tasks, a description of the methodology used in geophysical surveys the geophysical survey results, a summary of earthquake records in eastern Washington, a description of tectonic provinces, and a preliminary description of the regional tectonic setting of the Columbia Plateau.

8667 **(RHO-BWI-ST—10) Estimation of waste package performance requirements for a nuclear waste repository in basalt.** Wood, B.J. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jul 1980. Contract AC06-77RL01030. 51p. NTIS, PC A04/MF A01.

A method of developing waste package performance requirements for specific nuclides is described, and based on federal regulations concerning permissible concentrations in solution at the point of discharge to the accessible environment, a simple and conservative transport model, and baseline and potential worst-case release scenarios.

8668 **(SAND—80-1195) Unified creep-plasticity model for halite.** Krieg, R.D. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 12p. NTIS, PC A02/MF A01.

There are two national energy programs which are considering caverns in geological salt (NaCl) as a storage repository. One is the disposal of nuclear wastes and the other is the storage of oil. Both short-time and long-time structural deformations and stresses must be predictable for these applications. At 300K, the nominal initial temperature for both applications, the salt is at 0.28 of the melting temperature and exhibits a significant time dependent behavior. A constitutive model has been developed which describes the behavior observed in an extensive set of triaxial creep tests. Analysis of these tests showed that a single deformation mechanism seems to be operative over the stress and temperature range of interest so that the secondary creep data can be represented by a power of the stress over the entire test range. This simple behavior allowed a new unified creep-plasticity model to be applied with some confidence. The resulting model recognizes no inherent difference between plastic and creep strains yet models the total inelastic strain reasonably well including primary and secondary creep and reverse loadings. A multiaxial formulation is applied with a back stress. A Bauschinger effect is exhibited as a consequence and is present regardless of the time scale over which the loading is applied. The model would be interpreted as kinematic hardening in the sense of classical plasticity. Comparisons are made between test data and model behavior.

8669 **(SAND—80-1629) Comparisons of the structural behavior of three storage room designs for the WIPP project.** Krieg, R.D.; Stone, C.M.; Key, S.W. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 69p. NTIS, PC A04/MF A01.

A set of structural calculations has been made on three storage drift designs for storage of contact handled transuranic wastes (CH-TRU) at the site of the proposed Waste Isolation Pilot Plant near Carlsbad, New Mexico. One design is a quad room configuration, a four drift cluster of equal sized drifts. The second design has uniformly spaced drifts each of the same dimensions and with the same net extraction ratio as the first design. The third design is a uniformly spaced but much larger drift of slightly lower extraction ratio. The study emphasizes the relative merits of the three designs but only in regard to the deformations of the drifts and associated stresses in the surrounding rocks. The analyses included modeling of anhydrite, polyhalite, clay seams, and salt layering in a 90 m interval near the 663 m CH floor level. No thermal strains are included since the TRU wastes produce virtually no heat. The analyses showed that while all of the configurations may be acceptable, the uniformly spaced drifts are definitely superior to the quad room configuration. Strains exceeding a prescribed failure criterion in the 0.6 m thick salt at the floor surface were indicated in all configurations. This floor fracture was evident within a year in the quad room but delayed until seven years in the small single drift configuration. Very high strains were seen in the walls of the quad room with surface failure in one wall at ten years. The walls of the uniformly spaced drifts experienced much lower creep strains out to ten years. Floor heave was a possible deformation mode in all the analyses but was never observed.

8670 **(SAND—80-1928) Bell Canyon Test (BCT) cement grout development report.** Gulick, C.W. Jr.; Boa, J.A. Jr.; Buck, A.D. (Sandia National Labs., Albuquerque, NM (USA); Army Engineer Waterways Experiment Station, Vicksburg, MS (USA)). Dec 1980. Contract AC04-76DP00789. 77p. NTIS, PC A05/MF A01.

Development of the cement grout for the Bell Canyon Test was accomplished at the US Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi. Initial development work centered on a saltwater grout with Class H cement, fly ash, and an expansive additive. Testing of the saltwater grout showed suitable properties except for the interface between anhydrite rock and grout in small core samples. Higher than expected permeability occurred at the interface because of space between the grout and the anhydrite; the space was produced as a result of allowing the specimens to dry. A change to freshwater grout and proper care to prevent the specimens from drying alleviated this condition. The BCT-1FF freshwater grout mixture was used in both the plug ONE and ONEX field grouting operations. Testing of the development grout mixtures was also done at Dowell, Pennsylvania State University, and Oak Ridge National Laboratory. Results of the testing and evaluation by the four laboratories are included in the report. Field batching, mixing, and placement of the grout at the plug locations for both plug ONE and ONEX were satisfactory with adequate quality control. The freshwater grout mixture maintained adequate flow characteristics for pumpability for 3 1/2 h during each of the two field operations. Physical property and expansivity data for the field samples through 90 days' age are in general agreement with laboratory development data. A large number of samples were obtained for inclusion in the long-term durability studies and the geochemical programs. The high-density, low water-cement ratio expansive grout (BCT-1FF) is considered to be an excellent candidate for plugging boreholes at most locations (except through halite sections).

8671 **(SAND—80-2017C) Uncertainty analysis associated with radioactive waste disposal: a discussion paper.** Cranwell, R.M.; Helton, J.C. (Sandia National Labs., Albuquerque, NM (USA); Arizona State Univ., Tempe (USA)). 1980. Contract AC04-76DP00789. 33p. (CONF-801045—5). NTIS, PC A03/MF A01.

From DOE statistical symposium; Berkeley, CA, USA (29 Oct 1980).

The problem of incorporating and representing uncertainty in the analysis of geologic waste disposal has been discussed. The approach has been to view uncertainty analysis in the context of the problem of how to convert from a deterministic model (i.e., a function whoe input is a sequence of real numbers) to a probabilistic model (i.e., a function whoe input is a sequence of random variables and whose output is one or more random variables). Then, uncertainty analysis becomes the study of how the properaties of the output random variable are determined by the properties of the output random variable are determined by the properties of the input random variables. In the context of this approach, various questions which relate to uncertainty analysis for geologic waste disposal have been discussed and the manner in which the problems associated with these questions are being treated in the Sandia project has been indicated.

8672 **(SAND—80-2346C) Why consider subseabed disposal of high-level nuclear waste.** Heath, G.R.; Hollister, C.D.; Anderson, D.R.; Leinen, M. (Oregon State Univ., Corvallis (USA). School of Oceanography; Woods Hole Oceanographic Institution, MA (USA); Sandia National Labs., Albuquerque, NM (USA); Rhode Island Univ., Narragansett (USA). Graduate School of Oceanography). 1980. Contract AC04-76DP00789. 41p. (CONF-800420—5). NTIS, PC A03/MF A01.

From 2. international ocean disposal symposium; Woods Hole, MA, USA (15 Apr 1980).

Large areas of the deep seabed warrant assessment as potential disposal sites for high-level radioactive waste because: (1) they are far from seismically and tectonically active lithospheric plate boundaries; (2) they are far from active or young volcanos; (3) they contain thick layers of very uniform fine-grained clays; (4) they are devoid of natural resources likely to be exploited in the forseeable future; (5) the geologic and oceanographic processes governing the deposition of sediments in such areas are well understood, and are remarkably insensitive to past oceanographic and climatic changes; and (6) sedmentary records of tens of millions of years of slow, uninterrupted deposition of fine grained clay support predictions of the future stability of such sites. Data accumulated to date on the permeability, ion-retardation properties, and mechanical strength of pelagic clay sediments indicate that they can act as a primary barrier to the escape of buried nuclides. Work in progress should determine within the current decade whether subseabed disposal is environmentally acceptable and technically feasible, as well as address the legal, political and social issues raised by this new concept.

8673 **(SAND—80-2574C) Analysis of long-term soxhlet tests.** Kenna, B.T. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 28p. (CONF-801206—8). NTIS, PC A03/MF A01.

From ORNL conference on the leachability of radioactive solids; Gatinburg, TN, USA (9 Dec 1980).

Cyclic leaching patterns were exhibited by simulated waste glass and ceramic titanate (w/10% zeolite) materials during long-term elevated temperature soxhlet leaching studies. In the vitreous waste form, these patterns appear to be due to the formation and subsequent spallation of multilayered alteration products which were characterized using electron microprobe analysis. Electron microprobe studies of the leached titanate sample illustrated a more subdued attack of the surface with no alteration layer formation. During fabrication, cesium was concentrated in zeolite pockets which were leached, presumably by a process similar to that for glasses. One difficulty in leaching studies is the large sample volume required when very low concentrations of elements are to be determined. Studies presently in progress indicate that laser excited atomic fluorescence spectrometry is applicable to determining less than picogram quantities of cesium in 50 μL sample volumes.

8674 **(UCRL—15297(Vol.1)) Human factors analysis and design methods for nuclear waste retrieval systems. Human factors design methodology and integration plan.** Casey, S.M. (Anacapa Sciences, Inc., Santa Barbara, CA (USA)). Jun 1980. Contract W-7405-ENG-48. 153p. NTIS, PC A08/MF A01.

The purpose of this document is to provide an overview of the recommended activities and methods to be employed by a team of human factors engineers during the development of a nuclear waste retrieval system. This system, as it is presently conceptualized, is intended to be used for the removal of storage canisters (each canister containing a spent fuel rod assembly) located in an underground salt bed depository. This document, and the others in this series, have been developed for the purpose of implementing human factors engineering principles during the design and construction of the retrieval system facilities and equipment. The methodology presented has been structured around a basic systems development effort involving preliminary development, equipment development, personnel subsystem development, and operational test and evaluation. Within each of these phases, the recommended activities of the human engineering team have been stated, along with descriptions of the human factors engineering design techniques applicable to the specific design issues. Explicit examples of how the techniques might be used in the analysis of human tasks and equipment required in the removal of spent fuel canisters have been provided. Only those techniques having possible relevance to the design of the waste retrieval system have been reviewed. This document is intended to provide the framework for integrating human engineering with the rest of the system development effort. The activities and methodologies reviewed in this document have been discussed in the general order in which they will occur, although the time frame (the total duration of the development program in years and months) in which they should be performed has not been discussed.

8675 **Biological reduction of nitrate wastewater using a fluidized-bed bioreactor.** Pitt, W.W.; Hancher, C.W.; Patton, B.D. (Oak Ridge National Lab., TN (USA)). *CIM (Canadian Institute of Mining and Metallurgy) Bulletin (Canada);* **73**: No. 819, 161-170(Jul 1980).

There are a number of nitrate-containing wastewater sources as concentrated as 30 wt % NO_3^- and as large as 2000 m^3/day, in

the nuclear fuel cycle. The biological reduction of nitrate in wastewater to gaseous nitrogen, accompanied by the oxidation of a nutrient carbon source to gaseous carbon dioxide, is an ecologically sound and cost-effective method of nitrate waste disposal.

8676 **Conversion of radioactive ferrocyanide compounds to immobile glasses.** Shulz, W.W.; Dressen, A.L. (to Department of Energy, Washington, DC (USA)). Canadian Patent 1,078,164/A/. 17 May 1980. 9p.

The invention consists of a method of converting radioactive ferrocyanide precipitates of the general formula sup(134-1 37)Cs sub(a)Msub(b)(Fe(CN)sub(6))sub(c). x Hsub(2)O, where M represents Ni, Cu, Fe, Co, Cd, Mn, or UO_2; a, b, and c are integers; and x is zero or a small number, to an insoluble silicate glass comprising the step of melting said ferrocyanide in a charge comprising 10 to 30 percent said ferrocyanide, 15 to 25 percent sodium carbonate and a mixture of (a) 40 to 60 percent basalt and 5 to 15 percent boron trioxide or (b) 40 to 60 percent silica and 5 to 10 percent calcium oxide.

0530 Environmental Aspects

8677 **(CONF-801206—(Absts.)) ORNL conference on the leachability of radioactive solids.** (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 241p. NTIS, PC A11/MF A01.

From ORNL conference on the leachability of radioactive solids; Gatinburg, TN, USA (9 Dec 1980).

Abstracts of papers given at the following sessions are presented: leachability mechanisms and factors that influence leachability; methods used to measure leachability and present data; and empirical and theoretical models used to explain and to predict leachability - data and model accuracy.

8678 **(LA-UR—80-3468) Eh and fission product solubilities: two factors in the leaching of UO_2.** Ogard, A.E.; Duffy, C.J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 11p. (CONF-801206—5). NTIS, PC A02/MF A01.

From ORNL conference on the leachability of radioactive solids; Gatinburg, TN, USA (9 Dec 1980).

Eh was found to have a large effect on the dissolution of UO_2 in water at pH 4. As was estimated from thermodynamic data, the solubility was found to decrease and become very low as the oxygen fugacity, and therefore the Eh of the water, was decreased. Some of the rare earths and other actinides such as europium, cerium, americium, and plutonium released during the leaching of a spent fuel element behaved differently. These elements were not affected to any large extent by the variation in Eh of these experiments. It has been postulated that these elements reached their solubility limits and precipitated as the fuel was leached.

8679 **(PNL—3363) Topical report on release scenario analysis of long-term management of high-level defense waste at the Hanford Site.** Wallace, R.W.; Landstrom, D.K.; Blair, S.C.; Howes, B.W.; Robkin, M.A.; Benson, G.L.; Reisenauer, A.E.; Walters, W.H.; Zimmerman, M.G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1980. Contract AC06-76RL01830. 223p. NTIS, PC A10/MF A01.

Potential release scenarios for the defense high-level waste (HLW) on the Hanford Site are presented. Presented in this report are the three components necessary for evaluating the various alternatives under consideration for long-term management of Hanford defense HLW: identification of scenarios and events which might directly or indirectly disrupt radionuclide containment barriers; geotransport calculations of waste migration through the site media; and consequence (dose) analyses based on groundwater and air pathways calculations. The scenarios described in this report provide the necessary parameters for radionuclide transport and consequence analysis. Scenarios are categorized as either bounding or nonbounding. Bounding scenarios consider worst case or what if situations where an actual and significant release of waste material to the environment would happen if the scenario were to occur. Bounding scenarios include both near-term and long-term scenarios. Near-term scenarios are events which occur at 100 years from 1990. Long term scenarios are potential events considered to occur at 1000 and 10,000 years from 1990. Nonbounding scenarios consider events which result in insignificant releases or no release at all to the environment. Three release mechanisms are described in this report: (1) direct exposure of waste to the biosphere by a defined sequence of events (scenario) such as human intrusion by drilling; (2) radionuclides contacting an unconfined aquifer through downward percolation of groundwater or a rising water table; and (3) cataclysmic or explosive release of radionuclides by such mechanisms as meteorite impact, fire and explosion, criticality, or seismic events. Scenarios in this report present ways in which these release mechanisms could occur at a waste management facility. The scenarios are applied to the two in-tank waste management alternatives: in-situ disposal and continued present action.

0540 Health And Safety

REFER ALSO TO CITATION(S) 8658, 8671, 8679

8680 **(PNL—3514) Decontamination of high-level waste canisters.** Nesbitt, J.F.; Slate, S.C.; Fetrow, L.K. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1980. Contract AC06-76RL01830. 77p. NTIS, PC A05/MF A01.

This report presents evaluations of several methods for the in-process decontamination of metallic canisters containing any one of a number of solidified high-level waste (HLW) forms. The use of steam-water, steam, abrasive blasting, electropolishing, liquid honing, vibratory finishing and soaking have been tested or evaluated as potential techniques to decontaminate the outer surfaces of HLW canisters. Either these techniques have been tested or available literature has been examined to assess their applicability to the decontamination of HLW canisters. Electropolishing has been found to be the most thorough method to remove radionuclides and other foreign material that may be deposited on or in the outer surface of a canister during any of the HLW processes. Steam or steam-water spraying techniques may be adequate for some applications but fail to remove all contaminated forms that could be present in some of the HLW processes. Liquid honing and abrasive blasting remove contamination and foreign material very quickly and effectively from small areas and components although these blasting techniques tend to disperse the material removed from the cleaned surfaces. Vibratory finishing is very capable of removing the bulk of contamination and foreign matter from a variety of materials. However, special vibratory finishing equipment would have to be designed and adapted for a remote process. Soaking techniques take long periods of time and may not remove all of the smearable contamination. If soaking involves pickling baths that use corrosive agents, these agents may cause erosion of grain boundaries that results in rough surfaces.

8681 **(PNL-SA—7854) Training programs for emergency response personnel at Hanford.** Oscarson, E.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract AC06-76RL01830. 8p. (CONF-791203—11). NTIS, PC A02/MF A01.

From Health Physics Society meeting; Honolulu, HI, USA (10 Dec 1979).

The Three Mile Island reactor accident has focused attention on emergency planning and preparedness including selection and training of personnel. At Hanford, Pacific Northwest Laboratory (PNL) is in the unique position of providing emergency response personnel, planning, training and equipment not only for its own organization and facilities but also for the Hanford Site in general, as well as the Interagency Radiological Assistance Plan (IRAP) Region 8 Team. Team members are chosen for one or more of the emergency teams based upon professional education and/or experience as well as interest, aptitude and specialized knowledge. Consequently, the initial training orientation of each new team member is not directed toward general professional ability, but rather toward specialized knowledge required to carry out their assigned emergency tasks. Continual training and practice is necessary to maintain the interest and skills for effectively coping with major emergencies. The types of training which are conducted include: tests of emergency systems and/or procedures; drills involving plant employees and/or emergency team members (e.g., activation of emergency notification systems); short training sessions on special topics; and realistic emergency exercises involving the simulation of major

accidents wherein the emergency team must solve specific problems on a real time basis.

0550 Regulations

8682 **(ANL—80-13(Vol.3)) Fast critical assembly safeguards: NDA methods for highly enriched uranium. Summary report, October 1978-September 1979.** Bellinger, F.O.; Winslow, G.H. (Argonne National Lab., IL (USA)). Dec 1980. Contract W-31-109-ENG-38. 49p. NTIS, PC A03/MF A01.

Nondestructive assay (NDA) methods, principally passive gamma measurements and active neutron interrogation, have been studied for their safeguards effectiveness and programmatic impact as tools for making inventories of highly enriched uranium fast critical assembly fuel plates. It was concluded that no NDA method is the sole answer to the safeguards problem, that each of those emphasized here has its place in an integrated safeguards system, and that each has minimum facility impact. It was found that the 185-keV area, as determined with a NaI detector, was independent of highly-enriched uranium (HEU) plate irradiation history, though the random neutron driver methods used here did not permit accurate assay of irradiated plates. Containment procedures most effective for accurate assaying were considered, and a particular geometry is recommended for active interrogation by a random driver. A model, pertinent to that geometry, which relates the effects of multiplication and self-absorption, is described. Probabilities of failing to detect that plates are missing are examined.

8683 **(ANL—80-129) Application of international safeguards to fast critical assembly facilities. FY 1980 summary report.** (Argonne National Lab., IL (USA)). Dec 1980. Contract W-31-109-ENG-38. 36p. NTIS, PC A03/MF A01.

Nuclear materials inventory-verification techniques for large split-table fast critical assemblies are being studied in this program. Emphasis has been given to techniques that minimize fuel handling in order to reduce facility downtime and radiation exposure to the inventory team. The techniques studied include drawer seals, autoradiography, and spectral index measurements. Two-drawer sealing techniques have been studied, and the relative strengths and weaknesses are pointed out. The rod-type locking mechanism would not disrupt the reactor cooling air flow or interfere with autoradiography but is more expensive to implement. Passive autoradiography was used in a ZPPR inventory to verify to a 93% confidence level that less than 8-kg Pu was missing. The inventory was completed in four days by a five-member team with radiation exposures well within acceptable limits. Two autoradiographic film packages were developed to distinguish HEU from a DU matrix. The 30-mil pack requires an exposure between 4 and 16 hours and fits into most of the drawers. The 40-mil pack requires only a two-hour exposure but fits into less than half the drawers.

8684 **(LA—8447) Gross gamma-ray measurements of light water reactor spent-fuel assemblies in underwater storage arrays.** Moss, C.E.; Lee, D.M. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 16p. NTIS, PC A02/MF A01.

Two gross gamma-ray detection systems have been developed for rapid measurement of spent-fuel assemblies in underwater storage racks. One system uses a scintillator as the detector and has a 2% crosstalk between a fuel assembly and an adjacent void. The other system uses an ion chamber as the detector. The measurements with both detectors correlate well with operator-declared burnup and cooling-time values.

8685 **(LA—8657-MS) Conceptual design for the field test and evaluation of the gas-phase UF_6 enrichment meter.** Strittmatter, R.B.; Leavitt, J.N.; Slice, R.W. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 22p. NTIS, PC A02/MF A01.

An in-line enrichment monitor is being developed to provide real-time enrichment data for the gas-phase UF_6 feed stream of an enrichment plant. Data from proof-of-principle measurements using a laboratory prototype system are presented. A conceptual design for an enrichment monitor to be field tested and evaluated at the Oak Ridge Gaseous Diffusion Plant is reported.

8686 **(ORNL/TM—7673) Progress report for the Office of Safeguards and Security for FY 1980.** Smith, D.H.; Walker, R.L.; Carter, J.A. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01.

Progress in various areas funded by, or of interest to, the Office of Safeguards and Security is reported. A quadrupole mass spectrometer has arrived and is presently undergoing evaluation tests. Two new mass spectrometric data systems have been installed and are functioning satisfactorily. Round robin samples have been supplied to NBS for joint certification of isotopic content. Participation in the SALE program and efforts to improve precision of isotopic ratio measurements have continued, as has evaluation of the resin bead as an archive storage medium for safeguards samples.

8687 **(SAND—80-0160) International safeguards for a light-water reactor fuels reprocessing plant: containment and surveillance concepts.** Cameron, C.P.; Bleck, M.E. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1980. Contract AC04-76DP00789. 175p. NTIS, PC A08/MF A01.

Concepts for containment/surveillance for reprocessing plants are described, conceptual designs are developed, and their effectiveness is evaluated. A technical approach to design of containment/surveillance systems is presented, and design considerations are discussed. This is the second in a series of reports. The first described the basis for the study of international safeguards for reprocessing plants. In this second report, only containment/surveillance is discussed. The third report will discuss the integration of concepts for containment/surveillance and material accountancy.

06 FUSION FUELS

0601 Sources

8688 **(UCID—18509-80-2-3) Development of advanced technologies for photochemical tritium recovery. Bi-quarterly program report, 1 April-30 September 1980.** Herman, I.P.; Marling, J.B. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 6 Nov 1980. Contract W-7405-ENG-48. 28p. NTIS, PC A03/MF A01.

The laboratory facility for photochemical tritium separation research has been completed. Methods for synthesizing the monotritiated halogenated methanes have been developed. Notably, CTF_3 has been synthesized and spectrally analyzed. The CTF_3 vibrational frequencies are found to be in quite good agreement with earlier calculations.

0602 Processing

8689 **(KMSF-U—1004) Fabrication of metal shells.** O'Holleran, T.P.; Henderson, T.M.; Downs, R.L.; Nolen, R.L. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1980. Contract AC08-78DP40030. 9p. (CONF-801037—13). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

Small hollow metal spheres are needed as targets for particle-beam fusion experiments and as the inner fuel container for multi-shell targets. For the multishell application, shells fabricated of materials with high atomic numbers, e.g., gold, are of particular interest because they may effectively reduce preheating of the fuel. Because the shells must also contain the fuel mixture (deuterium and tritium) at high pressures, high strength materials, e.g., iron, are also of considerable interest. With the objective of proof of principle we have investigated several techniques of fabricating shells of metal or materials containing large fractions of high atomic number elements. These techniques, our experimental results and their evaluation are presented.

8690 **(KMSF-U—1007) Vacuum layer double-shell cryogenic inertial fusion targets.** Sims, R.J.; Musinski, D.L.; Pattinson, T.R.; Jacobs, R.B. (KMS Fusion, Inc., Ann Arbor, MI (USA); Jacobs (R.B.) Associates, Inc., Boulder, CO (USA)). 1980. Contract AC08-78DP40030. 10p. (CONF-801037—34). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

A double-shell cryogenic target has been suggested as a possible design for commercial Inertia Fusion (IF) reactors. Fabrication techniques have been developed to the point where these targets are available for experimental evaluation. Heat transfer from the fuel container to the outer shell is provided by a low-pressure exchange gas between the two shells. The pressure and mass of gas can be controlled by both temperature and the selection of the exchange gas. In the temperature range of interest (10 to 35°K) helium, a noncondensable gas, permits only a variation of pressure. A condensable gas, however, allows a variation in both the pressure and the mass density within the gap between the shells. A thermal model has been developed to evaluate the thermal characteristics of candidate target designs and estimate the fuel-layer uniformity history of the target.

8691 **(KMSF-U—1008) In-situ seeding of Hi-Z elements in glow discharge polymerized organic coatings.** Crawley, R.L.; Kool, L.B.; Nolen, R.L. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1980. Contract AC08-78DP40030. 10p. (CONF-801037—26). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

Currently favored IF target designs include low anti Z coatings seeded with small amounts of hi-Z elements. Three methods for incorporating hi-Z elements into glow discharge polymerized (GDP) coatings are being investigated. In the first method we have substituted an iodine atom onto the p-xylene molecule prior to GDP deposition. Chemical analysis, IR and NMR of the resultant coating indicate up to 7 at % iodine chemically incorporated. Other methods include ion implantation and GDP/sputtering codeposition. Metallic sputter/GDP codeposition has been reported, and is being installed in our latest deposition system.

8692 **(KMSF-U—1010) Furnace profile effects on glass shell formation.** O'Holleran, T.P.; Downs, R.L.; Homyk, B.D. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1980. Contract AC08-78DP40030. 15p. (CONF-801037—36). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

In the course of blowing glass shells in a furnace drop tower it has been observed that furnace temperature profile affects shell aspect ratio. Wall uniformity appears less sensitive to temperature profile as long as some minimum-time temperature history is achieved for a given glass composition. Quantitative results will be reported from experiments wherein the furnace temperature profile is systematically varied and the resultant shells are statistically analyzed for aspect ratio and wall uniformity.

8693 **(KMSF-U—1013) Capillary bulb fuel containers-high wall uniformity.** Anderson, P.R.; Henderson, T.M.; Downs, R.L. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1980. Contract AC08-78DP40030. 16p. (CONF-801037—30). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

Portions of document are illegible.

A method for producing glass fuel containers having uniform walls has been investigated. The first step in this method is compositionally altering a uniform layer of the container walls to the desired depth. This step can be accomplished by dealkalization of the glass layer at relatively high temperatures using a sulfur trioxide treatment. The second step in the method is that of selectively removing and discarding that portion of the glass which is not dealkalized. This step is facilitated by the comparatively high resistance of the altered glass layer to the hydrofluoric acid etching solutions employed. For example, layers of soda-aluminia-silicate glass as much as 50 μm in thickness have been substantially dealkalized by the SO_3-treatment. Glass tubing having these altered layers are found to be as much as fifty times as resistant to etching by hydrofluoric acid solutions as untreated soda-aluminia-silicate glass tubing.

8694 **(KMSF-U—1014) Polymer shells by the droplet method.** Kool, L.B.; Nolen, R.L.; Sherwood, K.W. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1979. Contract AC08-78DP40030. 19p. (CONF-801037—28). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

An AMFJ is used to generate a stream of identical droplets of a polymer solution by the break up of a column of polymer solution resulting from Rayleigh jet instabilities. Selected droplets from this stream are then charged and deflected by an electric field into a vertical furnace. As the solvent evaporates, a polymer bubble is formed which hardens into a shell by the time it reaches the bottom of the furnace. By varying the polymer, solvent, temperature, and droplet size, we have been able to make polymer shells with a wide range of selected diameters and aspect ratios. Using an acoustically modulated fluid jet we have produced various polymer shells with narrow distributions of diameters.

8695 **(KMSF-U—1015) Shells from compacted powders.** O'Holleran, T.P.; Nolen, R.L.; Downs, R.L.; Steinman, D.A.; Crawley, R.L. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1980. Contract AC08-78DP40030. 9p. (CONF-801037—29). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

Targets for inertial fusion require fuel containers (shells) with very precise tolerances. Power reactors are envisioned which will implode ten to twenty such targets per second. A means of mass production will be needed where virtually all of the shells produced will meet these exacting tolerances. As a step toward this goal, an automatic powder compacting press, PTX Pentronix Multipack 101, was used to mass produce cylindrical pellets, 260 μm diameter, of uniform mass, 10 to 20 μg, from particulate starting material. The starting powders included metal-organic gels, metal oxides and organic polymers. Shell blowing performance of the pellets was investigated over a range of pressing conditions.

8696 **(KMSF-U—1019) Analysis of glass shell blowing gases from metal-organic gels.** Downs R.L.; Ebner, M.A.; Homyk, B.D.; Nolen, R.L. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1979. Contract AC08-78DP40030. 15p. (CONF-801037—27). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

To develop better control of size, wall thickness, and shell quality, we have studied the physical and chemical transformations of metal-organic gels during heating, employing a number of thermal analytical techniques, such as pyrolysis-gas chromatography (PGC), pyrolysis-mass spectrometry (PMS), TGA, DTA and hot stage microscopy. This work will be the basis for mathematical modeling of the shell blowing process. The residual blowing gases in the glass spheres and the volatile gas content of the metal-organic gels were analyzed. The effect of gel aging on these was also studied. The primary component of the residual gases in the spheres is 70 to 80% carbon dioxide, with the balance oxygen and nitrogen; water has also been found in some cases. The potential volatiles in metal-organic gels depend on the aging history of the gel, and consist primarily of water, carbon dioxide, and a variety of organic species.

8697 **(SAND—80-2588) Hydrogen getter inhibition by a localized polymerization process.** Trujillo, R.E. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1980. Contract AC04-76DP00789. 38p. NTIS, PC A03/MF A01.

Catalytic hydrogenation of alkynes by palladium has been used in removing hydrogen from closed systems. Dimerized phenylpropargyl ether (DPPE) coated on an aluminum oxide substrate containing 5% palladium represents a typical hydrogen getter system. Samples of this getter were recovered from prototype weapon system components and were found to have impaired hydrogenation efficiency. Studies described in this report suggest that the loss of hydrogenation efficiency may result from localized polymerization occurring at the catalyst-substrate interface. This process is characterized by polymerization of 6% of the DPPE to a polymer product of low molecular weight, occurs at temperatures

below the melting point of DPPE, and requires the presence of palladium catalyst in order to occur.

8698 **Use of a radioactive tracer to determine the fraction of fusion target debris collected.** Campbell, E.M.; Hicks, H.G.; Mead, W.C.; Coleman, L.M.; Hatcher, C.W.; Dellis, J.H.; Boyle, M.J.; Larsen, J.T.; Lane, S.M. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). W-7405-ENG-48. *Journal of Applied Physics (U.S.);* **51**: No. 12, 6065-6067(Dec 1980).

In order to obtain the pusher attenuation length (rhoΔR) of inertial confinement fusion targets by neutron activation, it is necessary to know what fraction of the target debris is counted. One method of measuring this quantity experimentally is by means of a radioactive tracer. We demonstrate the usefulness of this technique by experiments utilizing a ^{24}Na tracer.

8699 **Spherical shock development near laser-heated microshell targets.** Leonard, T.A.; Hammerling, P. (KMS Fusion Inc., Box 1567, Ann Arbor, Michigan 48106). ES-C-02-4149. *Journal of Applied Physics (U.S.);* **51**: No. 12, 6130-6133(Dec 1980).

Spherical expansion of the luminous front around a laser-heated microshell target in 20 Torr of helium is compared with theory in the mass-dependent region. Microshell targets from 74- to 7970-ng initial mass irradiated with up to 0.13 TW (Terawatt) of 1.06-μm light were studied. Effects of the initial mass and changing γ on the front history are discussed. It is concluded that extraction of expansion energy from the front motion is not easily accomplished in this close-in region.

0608 Properties

8700 **(KMSF-U—1009) Strength of aluminum-containing glass shells.** Miller, W.J.; Downs, R.L.; Scott, L.A.; Schneggenburger, R.G. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1980. Contract AC08-78DP40030. 8p. (CONF-801037—31). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

Under external gas pressure glass shells appear to fail by buckling. This implies a glass composition-strength correlation since composition determines Young's modulus, a property directly proportional to buckling failure stress. For tensile loads, produced in gas filled shells, the effect of composition on glass strength is more indirect. Aluminum-containing glass has been chosen as a composition which is resistant to at least some of the currently recognized strength reducing mechanisms. The buckling strength of glass shells containing aluminum will be reported and compared to strength of glass shells with no aluminum.

8701 **(KMSF-U—1011) Chemical durability improvement of glass shells.** Anderson, P.R.; Scott, L.A.; Rolen, J.J. . (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1980. Contract AC08-78DP40030. 18p. (CONF-801037—35). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

High temperature chemical surface treatments have been used to improve the chemical durability and weatherability of spherical glass shells. The surface treatment consists of exposing heated glass shells to a mixture of sulfur dioxide, air and water vapor. A thin layer of the glass shell is dealkalized as a result of this treatment. The weatherability of treated alkali-silicate and alkali-calcia, silicate shells was improved, as determined qualitatively with the aid of a SEM. The chemical durability of silicate shells containing over 10 wt. % alkali but no calcia was improved by as much as a factor of thirty by the treatment. The chemical durability of glass shells was determined by analyzing the aqueous solutions used for extracting the constitutents of the shells. Treated glass shells containing calcia showed greater resistance to dissolution in water than untreated glass shells of the same composition, even though the untreated shells were relatively durable.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

8702 **(UCID—18509-79-4) Development of advanced technologies for photochemical tritium recovery. Quarterly progress report, October 1, 1979-December 31, 1979.** Herman, I.P.; Marling, J.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01.

Promising systems for photochemical recovery of tritium from deuterium (tritium removal from heavy water inventories) have been identified based on calculations of the energy levels of tritium-bearing halogenated methanes. Chloroform ($CDCl_3$) is an attractive working molecule using the CO_2 laser-pumped ammonia laser at 12.08 μ to selectively dissociate $CTCl_3$. The CO_2 laser may be directly usable in dissociation of dichloromethane $CDTCl_2$ at 10.8 μ, where CD_2Cl_2 is transparent. Isotopic exchange can be tied to heavy water to permit recycle of either system.

8703 **Determination of the overall distribution constant of deuterium in the GS process for heavy water production.** Chang, T.L.; Huang, H.T. (Peking Univ., China). *Separation Science and Technology (U.S.);* **15**: No. 3, 397-403(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

The overall distribution constant β of deuterium between mutually saturated phases of water and hydrogen sulfide has been experimentally determined as a function of temperature. The measurements were made with a teflon-sealed stainless steel exchange chamber of 500 ml capacity. At a total pressure of 20 kg/cm^2, the experimentally determined values of β were 2.335, 2.260, 1.650, and 1.586 at 30, 35, 130, and 135°C, respectively. These results are in good agreement with the corresponding calculated values.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 9727, 9728

0703 Isotopic Power Supplies

8704 **(LA—8673-PR) Milliwatt Generator Project. Progress report, April-September 1980.** Maraman, W.J. (comp.). (Los Alamos Scientific Lab., NM (USA)). Jan 1981. Contract W-7405-ENG-36. 46p. NTIS, PC A03/MF A01.

This formal biannual report covers the effort related to the Milliwatt Generator Project (MWG) carried out for the Department of Energy, Office of Military Applications, by the Los Alamos Scientific Laboratory (LASL). Most of the studies discussed here are of a continuing nature. Results and conclusions may change as the work continues. Published reference to the results cited in this report should not be made without the explicit permission of the person in charge of the work.

08 HYDROGEN

0801 Production

8705 **(BNL—51276) Advanced alkaline water electrolysis. Task 2 summary report. Model for alkaline water electrolysis systems.** Yaffe, M.R.; Murray, J.N. (Teledyne Energy Systems, Timonium, MD (USA)). Apr 1980. Contract AC02-76CH00016. 150p. NTIS, PC A07/MF A01.

Task 2 involved the establishment of an engineering and economic model for the evaluation of various options in water electrolysis. The mode, verification of the specific coding and four case studies are described. The model was tested by evaluation of a nearly commercial technology, i.e., an 80-kW alkaline electrolyte system, operating at 60°C, which delivers approximately 255 SLM,

hydrogen for applications such as electrical generation cooling or semiconductor manufacturing. The calculated cost of hydrogen from this installed non-optimized case system with an initial cost to the customer of $87,000 was $6.99/Kg H_2 ($1.67/100 SCF) on a 20-yr levelized basis using 2.5 cents/kWh power costs. This compares favorably to a levelized average merchant hydrogen cost value of $9.11/Kg H_2 ($2.17/100 SCF) calculated using the same program.

8706 **(DOE/ER/70129—T1) High temperature chemistry of hydrogen production cycles.** Hildenbrand, D.L. (SRI International, Menlo Park, CA (USA). Materials Research Lab.). Oct 1979. Contract AT03-76ER70129. 11p. NTIS, PC A02/MF A01.

Studies of the catalyzed decomposition of $MgSO_4$ were completed and a manuscript describing the work was prepared. $ZnSO_4$, ZnO $2ZnSO_4$, $CuSO_4$, and $Al_2(SO_4)_3$ were also found to yield SO_3 as the sole gaseous decomposition product, although SO_2 should predominate at equilibrium. As with other metal sulfate decompositions, a distinct progression of observed pressure with effusion orifice area indicates a significant kinetic barrier. Results obtained with the Zn, Cu, and Al sulfates are consistent with the decomposition mechanism postulated for $MgSO_4$. For $ZnSO_4$ and ZnO $2ZnSO_4$, derived equilibrium pressures indicate that the oxide and basic sulfate reaction products may be formed in a finely divided state of higher surface free energy and slightly lower thermodynamic stability than the normal macrocrystalline phases. None of the semiconducting oxides found to be catalytically effective with $MgSO_4$ had any detectable effect on the decomposition of $ZnSO_4$ or ZnO $2ZnSO_4$, but Pt had a substantial catalytic effect on the basic sulfate and a moderate effect on $ZnSO_4$. A sample of ZnO $2ZnSO_4$(s) was prepared by thermal decomposition of $ZnSO_4$ and submitted to Lawrence Livermore Laboratory for measurement of high temperature heat content by drop calorimetry; a second sample has been prepared and submitted for low temperature and solution calorimetry at the Albany Metallurgy Research Center of the Bureau of Mines. With $CuSO_4$, the solid phase decomposition product was found to be CuO rather than the CuO $CuSO_4$ phase reported in static experiments, and the pressures for moderate to large orifices are converging on the SO_3 equilibrium pressure when extrapolated to zero orifice size. For the smallest orifice sizes, there appears to be a partial catalysis of SO_3 to SO_2 and O_2 by the CuO product.

8707 **(TAC-H—80-003) Hydrogen energy: a bibliography with abstracts. Quarterly update, July-September 1980.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Nov 1980. 174p. Univ. of New Mexico, Albuquerque.

Hydrogen Energy is a continuing bibliography summary with abstracts of research and projections on the subject of hydrogen as a secondary fuel and as an energy carrier. This update cites 458 additional references. Subject areas include production, utilization, safety, materials, transmission, distribution, and storage.

0802 Storage

REFER ALSO TO CITATION(S) 8707, 9398, 9400

0803 Transport

REFER ALSO TO CITATION(S) 8707

0804 Marketing And Economics

8708 **(JPL-PUB—80-68) Assessment of potential future hydrogen markets in the US.** Kashani, A.K. (Jet Propulsion Lab., Pasadena, CA (USA)). Sep 1980. Contract AI01-77ET26203. 64p. NTIS, PC A04/MF A01.

A study of potential future hydrogen markets in the United States was performed for the International Energy Agency's (IEA) Hydrogen Program Annex III, Assessment of Potential Future Markets for the Production of Hydrogen from Water. The study was sponsored by the US Department of Energy, Energy Storage Systems Division, as the US contribution to Annex III, and conducted by the Jet Propulsion Laboratory under its Hydrogen Energy Storage Technology Project. The study projects future hydrogen markets for various use sectors, estimates the probable range of hydrogen production costs from various alternatives, discusses stimuli and barriers to the development of hydrogen markets, presents an overview of the status of technologies for the production and utilization of hydrogen, and, finally, discusses societal aspects of hydrogen production and utilization.

0806 Industrial And Commercial Use

REFER ALSO TO CITATION(S) 8707, 9398

0808 Properties

8709 **Nonrigid lattice model of hydrogen diffusion in a transition metal: a statistical mechanical approach.** Lee, M.H. (Instituut voor Thoeretische Fysika, Leuven, Belgium). Contract AS09-77ER1023. *Separation Science and Technology (U.S.);* **15**: No. 3, 457-474(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

The isotopes of hydrogen diffuse through transition metals such as Pd with different rates. The observed rates show a complicated temperature dependence including a reversed isotope effect. The diffusion generally behaves nonclassically. Also at moderate densities of hydrogen in Pd, the embedded hydrogen can undergo second-order (mean-field type) phase transition. The transition of this kind implies that there exist long-range attractive forces between H atoms mediated by the Pd lattice. These forces are expected to play a fundamental role in the quantum diffusion of a hydrogen-dense Pd system. To provide a first-principles description of hydrogen diffusion in Pd, we have constructed a physical model based on two ideas: (i) H atoms occupy the interstitial sites of the Pd lattice. (ii) the Pd lattice is nonrigid. To calculate the time correlation function (from which the diffusion coefficient may be deduced), we must for technical reasons remove the nonrigidity from the model via a unitary transformation. The transformation, however, introduces into the model some equivalent interactions. If the transformation is appropriately chosen, the transformed model can be expressed in terms of certain quasiparticles called diffusons. Our resultant model predicts that the diffusion process itself depends on the isotope mass as expected but that the phase transition temperature does not depend on the isotope mass. Our results seem to have experimental support. Also, under some appropriate limits, our model yields exact analytic expressions for the time correlation function.

09 OTHER SYNTHETIC AND NATURAL FUELS

REFER ALSO TO CITATION(S) 8933, 8934, 9220

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 8744, 8767, 9219, 9496, 9670, 10064

8710 **(DOE/ET/04096—T1) Continuous pyrolysis of biomass feedstocks in rotary kiln convertors. Final report.** Henry, H.H. Jr.; Kimzey, J.R.; Turpin, J.L.; MacCallum, R.N. (Arkansas Univ., Fayetteville (USA). Coll. of Engineering). 30 Aug 1979. Contract AS04-77ET04096. 124p. NTIS, PC A06/MF A01.

The biomass research program at the University of Arkansas has developed three experimental projects or tasks for the attainment of its objectives. They are: (1) utilization of the existing full scale convertor for testing and data acquisition at Jonesboro, Arkansas; (2) development of a scale model rotary pyrolytic convertor (bench scale research kiln); and (3) development of analytical laboratory services for the analysis of feedstocks and products, and for basic pyrolytic process studies. The project at Jonesboro, Arkansas, which aimed at testing the Angelo convertor concept through heat

and material balances over the available range of operations, could not completely achieve this objective because of the severe mechanical and structural deficiencies in the full scale convertor. A limited number of data have been taken in spite of the deficiencies of the machine. The scale model rotary kiln has been the most successful of the three projects. The kiln has been completed as planned and successfully operated with a number of feedstock materials. Good qualitative data have been obtained on conversion rate capacities, charcoal yields, and off gas combustion product temperatures. In all, about one hundred test runs were made in the scale model kiln. About 90% of the results expected were attained. The laboratory services project was designed to provide analytical testing for the other two projects and to do basic studies in biomass material conversion processes. The project delivered the testing services, but was severely restricted in the area of basic studies because of the failure of the main instrument, the gas chromatograph, to operate successfully. In all it is estimated that this project attained about 80% of its expected goals.

8711 **(SAND—80-8804) OH concentration in an atmospheric-pressure methane-air flame from molecular-beam mass spectrometry and laser-absorption spectroscopy.** Cattolica, R.J.; Yoon, S.; Knuth, E.L. (Sandia National Labs., Livermore, CA (USA); California Univ., Los Angeles (USA). Dept. of Chemical, Nuclear, and Thermal Engineering). Dec 1980. Contract AC04-76DP00789. 41p. (CONF-8010104—4). NTIS, PC A03/MF A01.

From Western states section of the combustion institute fall 1980 meeting; Los Angeles, CA, USA (20 Oct 1980).

The concentration of the OH radical in a stoichiometric methane-air flat flame at atmospheric pressure was measured with both laser-absorption spectroscopy and molecular-beam mass spectrometry (MBMS). The nonequilibrium peak OH concentrations and the OH decay rate measured from the two techniques were in good agreement. The OH profile from the MBMS measurements, however, was shifted downstream from the absorption measurements by approximately 5 times the sampling-orifice diameter. A comparison of temperature profiles from thermocouple measurements and from a molecular-beam time-of-flight technique exhibited a similar downstream shift. The MBMS measurements effectively sampled the gas properties approximately five orifice diameters ahead of the sampling-probe tip. Perturbation of the OH concentration profile using various sampling probes indicate the importance of minimizing the length of the sampling-orifice channel to reduce composition relaxation during sampling.

0902 Alcohol Fuels

8712 (CONF-800419—(Vol.2), pp 919-930) **Alternative fuels: methanol production in Sweden with alum shales as feed-stocks.** Oscarsson, B.; Skifferaktiebolag, R. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Current work underway in Sweden for the conversion of shales to methanol for fuel use as alcohol blends is described. The advantages of using shale as the feed material are outlined. The two sources of shale in Sweden are leached residue from uranium production and raw shale. The gasifying process is described. The char is used in a fluidized bed boiler to produce steam for use as process heat in neighborhood industries. The economics of operating the methanol plant are discussed and prices of methanol are projected. (DMC)

8713 **(DOE/CS/80010—T2) Farm Fuel Alcohol Project: preliminary report on facility design.** Pile, R.S.; Badger, P.C.; Roetheli, J.C.; Waddell, E.L. Jr. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Agricultural Development). Sep 1979. Contract AI01-80CS80010. 56p. NTIS, PC A04/MF A01.

This report describes the design of a farm-based ethanol production system to be built by TVA at Muscle Shoals, Alabama. This facility will include cooking, fermentation, and distillation equipment to allow production of 8000 to 12,000 gallons of fuel ethanol during a three to four month period each year. Output will be about 10 gallons of 190-proof ethanol per hour. Present components are sized to allow 12 to 14 hour daily operation as a semi-continuous batch system. Intent of the project is to document equipment and energy requirements, ethanol yields, and feasibility of small farm-based ethanol plants for farm fuel self-sufficiency. Cooking and fermentation will be batch-type operations, and packed distillation columns will be used for separating ethanol from the fermented beer. Energy recovery and waste heat use are integrated when feasible. The fermented beer will be fed directly to the distillation columns without separation of solids. Although this is an area of concern, an economical method of separation could not be identified.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 8576, 8744

8714 **(DOE/ET/11058—T3) Assessment of black liquor recovery boilers.** (Gilbert/Commonwealth, Reading, PA (USA)). May 1979. Contract AC01-77ET11058. 108p. NTIS, PC A06/MF A01.

In the paper making industry, pulpwood chips are digested and cooked to provide the pulp going to the refining and paper mills. Black liquor residue, containing the dissolved lignin binder from the chips, with a concentration of 12 to 16% solids, is further concentrated to 62 to 65% solids and mixed with salt cake, Sodium Sulfate (Na_2SO_4). The resulting concentrate of black liquor serves both as a fuel for generating steam in the boiler and also as the mother liquid from which other process liquors are recovered and recycled. Because the black liquor fuel contains high alkali concentrations, 18.3% sodium, 3.6% sulfur, an amount typical of midwestern bituminous coal, and measurable amounts of silica, iron oxides and other species, the black liquor boiler experience was reviewed for application to MHD boiler technology.

8715 (SAND—80-2744, pp 27-42) **Overview of present and future sludge regulations.** Tonetti, R. (Environmental Protection Agency, Washington, DC). Dec 1980.

From National symposium on the use of cesium-137 to process sludge for further reduction of pathogens; Denver, CO, USA (3 Sep 1980).

The US Environmental Protection Agency is mandated by several acts of Congress to develop sludge management regulations. These include the Resource Recovery and Conservation Act, Clean Water Act, Marine Resources and Sanctuaries Act, Clean Air Act, and Toxic Substances Control Act. Congress had two main goals: the protection of the public health and the promotion of the use of sludge as a natural resource. This presentation will review the development of present and anticipated regulation as they seek to support achievement of these goals.

13 HYDRO ENERGY

1301 Resources And Availability

8716 (ANL/EES-TM—96(Vol.2), pp 279-289) **Columbus, Ohio: an example of small hydropower potential in the midwest.** Pritchard, D. (Burgess and Niple, Ltd., Columbus, OH). Aug 1980.

From 12. IECEC conference on energy conservation in the treatment of industrial wastewaters; New Orleans, LA, USA (10 Dec 1979).

It is concluded that small scale, low-head hydroelectric power development is a feasible and worthwhile source of energy for municipalities in today's market. Hydroelectric power development is considered in the following topics: general characteristics and history; potential in the Midwest; applicable regulations; examples at sites in Columbus, Ohio; special implications of using water supply dams; incentive programs; and future needs.

1303 Plant Design And Operation

REFER ALSO TO CITATION(S) 9171

1304 Regulations And Licensing

8717 **(DOE/RA/23104—01) Hydropower licensing: a case study of Massachusetts' streamlined procedure.** Gardiner, P. (Massachusetts Executive Office of Energy Resources, Boston (USA)). Aug 1980. Contract AP01-79RA23104. 73p. NTIS, PC A04/MF A01.

Licensing procedures for hydroelectric projects in Massachusetts are enumerated, reviewed, and evaluated. (LCL)

8718 **(DOE/RA/50167—01) Use of mediation to resolve the dispute over low-head hydroelectric development at Swan Lake.** O'Connor, D. (New England Environmental Mediation Project, Boston, MA (USA)). Aug 1980. Contract AC01-77PR50167. 111p. NTIS, PC A06/MF A01.

In 1978, the Maine Hydroelectric Development Corporation announced that the company planned to renovate five dams on the Goose River near Belfast, Maine to generate electricity. The most important part of the plan involved the use of the first of the dams, at the lower end of Swan Lake, to regulate the flow of water to the downstream dams. For Maine Hydro, management of the Swan Lake dam could make an otherwise marginal proposal lucrative. However, Swan Lake is vitally important to the residents of Swanville. The town was so concerned about the impact of this proposed hydroelectric project that it petitioned the Federal Energy Regulatory Commission (FERC) to deny Maine Hydro's application on the grounds that it would damage the environment, reduce property values and eliminate recreational opportunities for its citizens. This report was written by the mediator of the dispute and represents the views and behavior of the parties as the mediator understood them. It is intended to present the mediator's observations in a way which will inform and assist others who may someday face a difficult situation like the one the Town of Swanville and Maine Hydroelectric Development Corporation faced, and successfully resolved, in the spring and summer of 1979.

1305 Economics And Management

REFER ALSO TO CITATION(S) 9172

1306 Environmental Aspects

REFER ALSO TO CITATION(S) 8718

8719 **(ORNL/TM—7521) Analysis of environmental issues related to small-scale hydroelectric development IV: fish mortality resulting from turbine passage.** Turbak, S.C.; Reichle, D.R.; Shriner, C.R. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-48. 120p. NTIS, PC A06/MF A01.

This document presents a state-of-the-art review of literature concerning turbine-related fish mortality. The review discusses conventional and, to a lesser degree, pumped-storage (reversible) hydroelectric facilities. Much of the research on conventional facilities discussed in this report deals with studies performed in the Pacific Northwest and covers both prototype and model studies. Research conducted on Kaplan and Francis turbines during the 1950s and 1960s has been extensively reviewed and is discussed. Very little work on turbine-related fish mortality has been undertaken with newer turbine designs developed for more modern small-scale hydropower facilities; however, one study on a bulb unit (Kaplan runner) has recently been released. In discussing turbine-related fish mortality at pumped-storage facilities, much of the literature relates to the Ludington Pumped Storage Power Plant. As such, it is used as the principal facility in discussing research concerning pumped storage.

14 SOLAR ENERGY

8720 **(AD-A—083000) Solar energy. Report bibliography, January 1955-September 1978.** (Defense Technical Information Center, Alexandria, VA (USA)). Apr 1980. 186p. NTIS, PC A09/MF A01.

This bibliography is a selection of unclassified and unlimited distribution references on solar energy. These citations of reports present information on performance characteristics, fabrication, development of power levels and energy conversion. Four computer-generated indexes are provided.

8721 (CONF-800995—, pp 3-5) **Western SUN: setting solar goals in a real world.** Aitken, D.W. (Western SUN, Portland, OR). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The goals, mission, and participants of the Western Solar Utilization Network (Western SUN) are reviewed briefly. (MHR)

8722 **(DOE/SF/10951—T1) Systems development program study for the Office of Solar Applications. Final report.** (Kando (Paul F.), Inc., Washington, DC (USA)). 28 Dec 1979. Contract AP03-80SF10951. 41p. NTIS, PC A03/MF A01.

An analysis of the existing program, recommendations for areas of emphasis in order to reach the stated goal, recommendations for changes in program balance in response to the needs of the marketplace, and a study of how field organizations may be most effectively utilized in the achievement of program goals are included. (MHR)

8723 (ORNL—5638, pp 170-193) **Solar and Special Studies Section.** Chester, C.V. Jun 1980.

In Energy Division annual progress report for period ending September 30, 1979.

The Solar and Special Studies Section program consists of two parts: solar projects and emergency technology. Emergency technology is the civil-defense-related activity that was the original purpose of the section and remains a strong interest. The solar program within the section consists of technical monitoring of activities in agriculture and photovoltaics, research dealing with innovative structures and passive solar, and two very small exploratory projects on high-temperature coatings and development of a Freon-charged solar still. With the publication this year of Nuclear War Survival Skills (ORNL-5037), the emergency technology program emphasis is shifting slightly away from the nuclear war threat to the civilian population toward smaller-scale threats such as reactor accidents and release of radioactive aerosols by terrorists. The accident at Three Mile Island provided the impetus to develop a low-range homemade radiation meter and to begin a study of large-scale environmental decontamination. Civil-defense officials expressed strong interest in expedient protection against toxic aerosols, adding impetus to the publication of results in this field. Estimates have been made of the long-term incidence of cancer in survivors of a nuclear war when a modest but effective civil defense program had been in effect.

8724 **(SERI/SP—763-718) Solar energy in Italy: a profile of renewable energy activity in its national context.** Shea, C.A. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1980. Contract AC02-77CH00178. 76p. NTIS, PC A05/MF A01.

The following are included: country overview; energy summary; Italian Republic-geopolitical, economic, and cultural aspects; the energy profile; imported energy sources; solar energy research and development; solar energy organizations; solar energy related legislation and administration policies; and international agreements, contacts, manufacturers, and projects. (MHR)

8725 **(JPRS—76946) China report: economic affairs, No. 102.** (Joint Publications Research Service, Washington, DC (USA)). 5 Dec 1980. Translation of various articles. 31p. NTIS.

Progress in China in the following areas of solar energy utilization are reported: solar ovens; solar water heaters; solar collec-

tors; solar heating, air conditioning, and refrigeration; use of solar energy in agriculture; solar cells, solar power generation, and other uses. (MHR)

8726 **SUN II.** Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979). 769p. (CONF-790541—(Vol.2)).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

One hundred fifty-seven of the 176 papers were entered into the data file separately. Nineteen papers were previously entered into the file and can be found in the report number index under report CONF-790541. (WHK)

1401 Resources And Availability

8727 (CONF-800995—, pp 7-15) **How performance is reported in the National Solar Data Network.** Rossi, S.M. (Automation Industries, Inc., Silver Spring, MD). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The organization of the Monthly Performance Reports, the Solar System Performance Evaluation Reports, and the Monthly Environmental Data Reports are described. Examples from typical reports are presented. (MHR)

8728 **(SOLAR/0010—80/12) Environmental data for sites in the National Solar Data Network.** (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). Dec 1980. Contract AC01-79CS30027. 245p. NTIS, PC A11/MF A01.

The environmental data for the NSDN are presented in the form of tables for each solar site. The solar sites are grouped into 12 zones, each of which consists of several adjacent states. The solar energy sites are in alphabetical sequence within each zone. The tables provide available meteorological data for reporting sites in the NSDN as follows: Insolation - the insolation table presents the total, diffuse, direct, maximum, and extra-terrestrial radiation for the solar site. It also shows the ratio of total extra-terrestrial radiation, as a percent. Temperature - the temperature table gives the average, daytime, nightime, maximum, minimum and inlet-water temperatures for the solar site. Additional tables are presented for some of these NSDN sites, supplying either wind or relative humidity data, or both. Wind - all of the passive and some of the active solar sites are equipped with wind sensors. These provide information for two wind tables. The first furnishes wind speed and direction. The second table correlates wind speed with time (hours for a range of speeds) for each day. Humidity - the humidity table provides relative humidity values for day and night. A technical discussion of the instruments and measurements used to obtain these data tables is given. A map illustrating the climate zones is provided.

8729 **Solar design by the Cosine Hour method.** Bossel, U. (SOLENTEC GmbH, Adelebsen, Germany). pp 1195-1198 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A new approach is suggested for the prediction of the solar energy received by surfaces of arbitrary tilt and orientation. The method is based on the Cosine Hour integral. This geometric parameter measures the time-equivalent of solar exposure in units of hours of perpendicular insolation. For any surface and day the number of Cosine Hours becomes directly proportional to the amount of energy received under ideal weather conditions. For partially cloudy skies the Cosine Hour method yields excellent answers when a 3-modal insolation model is used. Surface orientations can be easily optimized with respect to energy collection by inspection methods when the Cosine Hour tables are used.

8730 **Measurement of solar radiation.** Proctor, D. (Commonwealth Scientific and Industrial Research Organization, Highett, Australia); Trickett, E.S. pp 1450-1452 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The sources of error and changes in calibration that can occur in pyranometers are discussed. Several new prototype pyranometers have been constructed and tested. These pyranometers, by suitably choosing the materials of construction, have output signals independent of ambient temperature. Measured data presented shows that in this way they are superior to the current pyranometers in use throughout the world, particularly when mounted in an inclined position.

8731 **Monthly average daily insolation on overhang shaded windows.** Jones, R.E. Jr. (Univ. of Colorado, Colorado Springs). pp 1610-1614 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A method is presented for calculation of the monthly average daily insolation on windows of arbitrary azimuth shaded by overhangs of effectively infinite lateral extent. The method considers beam, diffuse and reflected radiation and is based on an extension to a totally arbitrary orientation of the methods of Liu and Jordan and of Klein for estimating the radiation on tilted surfaces. This extension also allows the determination of daily insolation on skylights and windows having orientations away from the equator.

8732 **Determination of the shadows area induced on horizontal and vertical surfaces anyway oriented.** Calarco, A.; De Luca, M. (I.U.S.A. Istituto di Tecnologia, Calabria, Italy). pp 1620-1624 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A numerical method for the geometric location of the shadows produced by a building on a vertical or horizontal surface is developed. The method also determines the area of the shadows and especially the shadow factor, defined as the area of that part of the shadow which intersects a unit rectangle, suitably selected on the surface. In view of its application to several problems (urban planning, correction of thermic load tables), the dependence of the shadow factor upon some parameters is studied. The results for particular cases are presented.

1403 Economics

REFER ALSO TO CITATION(S) 8833, 8842, 8913, 8985, 9185

8733 **(ANL/EES-TM—116) Employment impacts of selected solar and conventional energy systems: a framework for comparisons and preliminary findings.** Smeltzer, K.K. (Argonne National Lab., IL (USA)). Jan 1980. Contract W-31-109-ENG-38. 37p. NTIS, PC A02/MF A01.

Preliminary comprehensive analyses of quantitative and qualitative employment effects of selected solar and conventional energy systems are presented. It proposes a framework for analyzing the direct, indirect, induced, displacement, disposable income, and qualitative employment effects of alternative energy systems. The analyses examine current research findings on these effects for a variety of solar and conventional energy sources and compare expected employment impacts. In general, solar energy systems have higher direct and indirect employment requirements than do conventional energy systems. In addition, employment displaced from conventional sources and employment effects due to changes in consumers' disposable income are highly significant variables in net employment comparisons. Analyses of the size and location of projected energy developments suggest that dispersed solar energy systems have a more beneficial impact on host communities than do large conventional facilities, regardless of the relative magnitude of employment per unit of energy output.

8734 (CONF-800995—, pp 105-112) **Financing solar energy for the consumer: an overview of new trends.** Gardels, M.C. (California Western SUN, Los Angeles). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The trends in consumer financing for solar systems are reviewed. The issues concomitant with the different methods of fi-

nancing are explored. Three primary methods of subsidizing the solar purchaser, tax credits, rebates, and no/low interest loans, are discussed. (MHR)

1404 Environmental, Legal, And Institutional Aspects

8735 **(DOE/ER—0090) Environmental assessment for the satellite power system concept development and evaluation program: atmospheric effects.** Rote, D.M.; Brubaker, K.L.; Lee, J.L. (Argonne National Lab., IL (USA)). Nov 1980. Contract W-31-109-ENG-38. 129p. NTIS, PC A07/MF A01.

The US Department of Energy (DOE) has undertaken a preliminary, three-year program to investigate the impacts of the construction and operation of a satellite power system, of unprecedented scale. The Department of Energy's program, titled The Concept Development and Evaluation Program, focused its investigations on a Reference System description that calls for the use of either silicon (Si) or gallium aluminum-arsenide (GaAlAs) photovoltaic cells on 60 satellites to be constructed in GEO over a 30-yr period. Rectennas would be constructed on the ground to receive microwave energy from the satellites. Each satellite-rectenna pair is designed to produce 5 GW of power on an essentially continuous basis for use as a baseload power source for an electric power distribution system. The environmental assessment part of the program was divided into five interdependent task areas. The present document constitutes the final technical report on one of the five task areas, the Assessment of the Atmospheric Effects, and as such presents an in-depth summary of work performed during the assessment program. The issues associated with SPS activities in the troposphere are examined. These include tropospheric weather modification related to rectenna operations and rocket launches, and air quality impacts related to rocketlaunch ground clouds. Then progressing upward through the various levels of the atmosphere, the principal middle and upper atmospheric effects associated with rocket effluents are analyzed. Finally, all of the potential SPS atmospheric effects are summarized.

8736 **(DOE/ER/10041—T11) Satellite power system (SPS) public outreach experiment.** McNeal, S.R. (PRC Energy Analysis Co., Los Angeles, CA (USA)). Dec 1980. Contract AC01-79ER10041. 69p. NTIS, PC A04/MF A01.

To improve the results of the Satellite Power System (SPS) Concept Development and Evaluation Program, an outreach experiment was conducted. Three public interest groups participated: the L-5 Society (L-5), Citizen's Energy Project (CEP), and the Forum for the Advancement of Students in Science and Technology (FASST). Each group disseminated summary information about SPS to approximately 3000 constituents with a request for feedback on the SPS concept. The objectives of the outreach were to (1) determine the areas of major concern relative to the SPS concept, and (2) gain experience with an outreach process for use in future public involvement. Due to the combined efforts of all three groups, 9200 individuals/organizations received information about the SPS concept. Over 1500 receipients of this information provided feedback. The response to the outreach effort was positive for all three groups, suggesting that the effort extended by the SPS Project Division to encourage an information exchange with the public was well received. The general response to the SPS differed with each group. The L-5 position is very much in favor of SPS; CEP is very much opposed and FASST is relatively neutral. The responses are analyzed, and from the responses some questions and answers about the satellite power system are presented in the appendix. (WHK)

8737 **(DOE/ER/10041—T12) Satellite Power System (SPS) societal assessment.** (PRC Energy Analysis Co., Los Angeles, CA (USA)). Dec 1980. Contract AC01-79ER10041. 57p. NTIS, PC A04/MF A01.

Construction and operation of a 60-unit (300 GW) domestic SPS over the period 2000 to 2030 would stress many segments of US society. A significant commitment of resources (land, energy, materials) would be required, and a substantial proportion of them would have to be committed prior to the production of any SPS electricity. Estimated resource demands, however, seem to be within US capabilities. Modifications will be required of institutions called upon to deal with SPS. These include financial, managerial and regulatory entities and, most particularly, the utility industry. Again, the required changes, while certainly profound, seem to be well within the realm of possibility. Enhanced cooperation in international affairs will be necessary to accommodate development and operation of the SPS. To remove its potential as a military threat and to reduce its vulnerability, either the SPS itself must become an international enterprise, or it must be subject to unrestricted international inspection. How either of these objectives could, in fact, be achieved, or which is preferable, remains unclear. Forty-four concerns about the SPS were identified via a public outreach experiment involving 9000 individuals from three special interest organizations. The concerns focused on environmental impacts (particularly the effects of microwave radiation) and the centralizing tendency of the SPS on society. The interim results of the public outreach experiment influenced the scope and direction of the CDEP; the final results will be instrumental in defining further societal assessment efforts.

8738 (DOE/EV—0128, pp 93-108) **Solar, geothermal, and energy conservation.** Jun 1980.

In Division of Environmental Control Technology Program, 1979.

Environmental control assessment activities for solar energy, geothermal energy, and energy conservation are discussed. Environmental problems associated with hazardous materials used in solar heating and cooling were assessed. Other activities supported are the assessment of environmental controls needed for the energy resource of biomass and a preliminary assessment of the sound levels for large wind turbine generators. Studies were completed on the state-of-the-art liquid waste control systems and gaseous cleanup systems for geothermal energy. Noise abatement studies were initiated to assess the noise impact of geothermal energy and to determine the most effective methods for noise reduction. Other evaluations include (1) identification and evaluation of disposal schemes for compressed air energy storage; (2) evaluation of the impact of current industrial pollution control practices in waste treatment technology; (3) review of environmental regulations concerning the effect of overhead electric transmission lines.

8739 **(SERI/SP—98155-1) Solar envelope concepts: moderate density building applications. Final report.** Knowles, R.L.; Berry, R.D. (University of Southern California, Los Angeles (USA). School of Architecture). Apr 1980. Contract AC02-77CH00178. 144p. NTIS, PC A07/MF A01.

Solar energy utilization in urban areas requires public guarantees that all property owners have direct access to the sun. The study examines the implications of this premise in relation to the need for cities to also encourage or accommodate rebuilding and future development. The public policy mechanism for guaranteeing solar access is conceptualized as a solar zoning envelope that allows the largest possible building bulk on a land parcel without shadowing neighboring properties during specified times. Step-by-step methods for generating solar envelopes are described with extensive drawings, showing a variety of urban platting and lot configurations. Development and design possibilities are examined on a selected set of Los Angeles sites with typically diverse urban characteristics. Envelope attributes suitable for encouraging moderate-density commercial and residential building are examined in the context of two hypothetical but realistic development programs: one for speculative office buildings and one for condominium housing. Numerous illustrations of envelope forms and prototypical building designs are provided. The results of development simulation studies on all test sites are tabulated to show building bulk, density, land-coverage and open space characteristics obtainable under the hypothesized envelopes.

8740 **(SERI/TR—722-583(Vol.1)) Making solar laws work. A study of state solar energy incentives.** Roessner, J.D. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1980. Contract AC02-77CH00178. 39p. NTIS, PC A03/MF A01.

The results of a research investigation of solar financial and research, demonstration, and development R D & D) incentive programs in 18 states are summarized. The investigation focuses upon

implementation - the organization and administrative processes required to convert a law into a viable program. Eleven financial and 12 RD & D programs were investigated. Results indicate that four conditions are common to successful implementation of both types of incentive programs: the opportunity to use solar energy as a heating source; characteristics of the agency selected to complement the law; involvement of outside groups in program implementation; and the specificity of guidance given to those responsible for implementation. Other conditions specific to the implementation of each type of program are discussed as well as the implications of these findings for state and federal policy makers.

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 8710, 8713, 8738, 8885, 9228, 9229, 9249, 9306, 9433

8741 (AD-A—083092) Development of high efficiency stacked multiple bandgap solar cells. Final report, 1 August 1978-30 September 1979. Bedair, S.M.; Hauser, J.R.; Lamorte, M.F.; Phatak, S.; Timmons, M.L. (Research Triangle Inst., Durham, NC (USA)). Oct 1979. Contract F33615-78-C-2077. 102p. NTIS, PC A06/MF A01.

The objective of this research was to develop the technology required to fabricate two-junction, cascade solar cell assemblies having conversion efficiencies exceeding 25 percent when operating at 25°C under 1 sun, AM O conditions. The experimental effort has focused on several different III-V ternary and quaternary materials that show promise for use in fabricating a cascade cell. These include GaAlAs, GaInAs, GaInP, GaAsSb, and GaAlAsSb. The work also includes theoretical calculations of cascade solar cell performance over a wide range of operating temperatures.

8742 (AD-A—084831) Ribbon growth of single crystal GaAs for solar cell application. Interim report, 15 August 1978-15 August 1979. Gould, T.A.; Seidensticker, R.G.; Mazelsky, R. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). 30 Nov 1979. Contract F33615-78-C-2031. 65p. NTIS, PC A04/MF A01.

This report describes the first 12 months of a program to develop GaAs dendritic web. Liquid encapsulation with B203 is used to suppress As vaporization from the melt. Standard web growth system design and experimental techniques which have been developed at Westinghouse for Si web are also utilized for the GaAs program. Critical optimization of thermal geometry is achieved with computerized thermal modeling. Dendritic growth and web buttoning of GaAs have been observed in the current program. Web crystals have not yet been produced, however, a piece of primitive web material has been recovered from the system. The growth behavior and the morphology of GaAs dendrites, buttons, and web material are analogous to the results obtained from successful Si and Ge web growth systems. The thermal modeling results also indicate that the liquid encapsulated GaAs system is suitable for web growth.

8743 (BMI—2054(Vol.3)) Development of sweet sorghum as an energy crop. Volume III. Integration concepts. Scantland, D.A.; Riddle, W.E.; McClure, T.A.; Woodford, P.G.; Honton, E.J.; Lipinsky, E.S. (Battelle Columbus Labs., OH (USA)). 12 Dec 1980. Contract W-7405-ENG-92. 147p. NTIS, PC A07/MF A01.

For the past 3 years, Battelle's Columbus Division and several co-investigators have conducted interregional investigations related to biomass and sugar production for conversion to alcohol and other fuels. These investigations have emphasized primarily the production of sweet sorghum and sugarcane due to their ability to produce high biomass and readily fermentable sugars' yields which allow a highly favorable energy balance when converted to ethanol. The primary goal of the 1979 research program was to determine the agronomic and economic feasibility of developing sweet sorghum, sweet sorghum hybrids, and sugarcane as energy-producing crops in selected geographic regions of the United States. The objectives of the research include the following: (1) to conduct a prefeasibility analysis of the potential for integrating sugarcane and sugar beet production/processing with sweet sorghum; and (2) to formulate an analytical approach to estimate the economic impact of growing sweet sorghum as an energy crop upon the US agricultural system. This volume is comprised of two separate investigations pertaining to potential integration of sweet sorghum into US agriculture. The first investigation entitled, Economic Potential for Integrating Alcohol Fuels Production from Sweet Sorghum with Other Carbohydrate Crops conducted independently, looks at integration of sweet sorghum from a microeconomic viewpoint, i.e., what would be the effects of combining sweet sorghum with other sugar crops to produce alcohol in terms of plant investment and operating costs.

8744 (DOE/CS/21059—01) Biomass energy systems program summary. Information current as of September 30, 1979. (PRC Energy Analysis Co., McLean, VA (USA)). Oct 1980. Contract AC01-77ET21059. 190p. NTIS, PC A09/MF A01.

This program summary describes each of the DOE's Biomass Energy System's projects funded or in existence during fiscal year 1979 and reflects their status as of September 30, 1979. The summary provides an overview of the ongoing research, development, and demonstration efforts of the preceding fiscal year as well. (DMC)

8745 (DOE/ET/20077—1) Mobile wood chippers: a collection of data on currently available chippers in US and abroad. Crossley, F.R.E.; Sullivan, J. (eds.). (Massachusetts Univ., Amherst (USA). Dept. of Civil Engineering). 1980. Contract FG01-78ET20077. 178p. NTIS, PC A09/MF A01.

A discussion of the availability and design of mobile chippers which can be used in or near forests is presented. These chippers may be located at the mill, at the landing when logs or whole trees are skidded from the stump, or near the stump. There are a number of chippers commercially available for the first 2 options but only 2 concepts have been developed for option 3. Chippers have been separated into 6 classes. Photographs and specifications of chippers of each class are presented. (DMC)

8746 (DOE/ET/23029—T3) Gasification research on wood grow project. Flanigan, V.J. (Missouri Univ., Rolla (USA)). 9 Jan 1981. Contract AC02-79ET23029. 47p. NTIS, PC A03/MF A01.

The GROW (Gasification Research on Wood) project consists of a research project on thermochemical degradation of wood particles (sawdust or hammermilled wood) on a pilot plant scale and utilizes a 100 cm (40 in.) diameter fluidized sand bed reactor at capacities of up to 1000 Kg/Hr (2200 lb/hr). Supplementary facilities include wood preparation and air conveying, a wood feed bin, feed and transfer screws, an air compressor with storage and filter tanks, an electrical preheater, a propane-fired preheater, a cyclone separator removing solids from product gas, a water scrubber to cool and clean product gas, a scrubber wate settling tank, a scrubber water cooler, a knockout drum, a demister to be installed in the future, a recycle compressor for recirculation, a recycle gas storage tank, a flare and stack with air blower to dispose of the gas, 2 CO_2 stripper columns to be installed in the future to remove CO_2 by caustic adsorption, caustic tanks, and the necessary piping, pumps, sampling, and measurement facilities. A brief report of progress on the project is given, followed by the safety implementation plan and operating, maintenance, and safety procedures. (MHR)

8747 (DOE/ET/23108—6) Photovoltaic mechanisms in polycrystalline thin-film silicon solar cells. Quarterly report No. 5, August 1-October 31, 1980. Redfield, D. (RCA Labs., Princeton, NJ (USA)). Nov 1980. Contract AC01-79ET23108. 22p. NTIS, PC A02/MF A01.

Knowledge of the electronic behavior of grain boundaries in polycrystalline silicon has advanced significantly as a consequence of new measurements of the effects of annealing on the electrical characteristics of grain boundaries. Most polycrystalline Si is found to have negligible potential barriers at the boundaries before heating, and substantial barriers after heating. On the basis of a very new model of Schottky-barrier formation, these results lead to the interpretation that most boundaries are very clean before heating and that the barriers arise when impurities diffuse to the boundaries and induce lattice defects in the adjacent Si. Oxygen is the most likely impurity to be responsible, but only on circumstantial evi-

dence. The relation to existing models and the remaining questions point the way to further understanding.

8748 **(DOE/ET/27256—T7) Ethanol: a brief economic evaluation.** (Oregon Inst. of Tech., Klamath Falls (USA). Geo-Heat Utilization Center). Sep 1980. Contract FG06-79ET27256. 12p. Dep. NTIS, PC A02/MF A01.

Del Rio Farms, Inc. has a large farm in the Imperial Valley area of California, a known geothermal resource area. The 10 MW geothermal flash steam power plant, operated by Union Oil Company, is located on their property. Presently the owners have under consideration a 10 million gallon per year ethanol plant. The initial feed to the plant would be corn, with sugar beets as a possible alternate feed. The ultimate plan is to use waste products and biomass feed stocks. Geothermal water would provide the necessary process heat for the plant. An economic evaluation was performed to assist in the planning. Each of the following conclusions are based on an ethanol plant that produces 10 million gallons of ethanol per year. Over a 20 year period, the plant using a corn feed stock would generate a rate of return of +12% on a total equity capital investment of $33,000,000. Over a 15 year period, the plant using a corn feed stock is probably not economically feasible since it would have a rate of return less than 12% or a total equity capital investment of $33,000,000. A corn feed stock plant operates at a loss for the first seven years if 95% of the $33,000,000 cost is debt financed. The plant is economically feasible only if offsetting energy income from other profitable operation permits taking advantage of investment tax credits and depletion allowances that are available. If this is true, the project is highly feasible, paying back twice the 5% equity capital in the first year.

8749 **(DOE/JPL/954527—80/15) Investigation of test methods, material properties, and processes for solar cell encapsulants. Annual report.** Willis, P.B.; Baum, B.; Schnitzer, H.S. (Springborn Labs., Inc., Enfield, CT (USA)). Jul 1980. Contract NAS-7-100-954527. 104p. NTIS, PC A06/MF A01.

The goal of this program is to identify, evaluate, and recommend encapsulant materials and processes for the production of cost-effective, long-life solar cell modules. Technical activities during the past year have covered a number of topics and have emphasized the development of solar module encapsulation technology that employs ethylene/vinyl acetate, copolymer (EVA) as the pottant. These activities have included: (1) continued production of encapsulation grade EVA in sheet form to meet the needs of the photovoltaic industry; (2) investigations of three non-blocking techniques for EVA sheet; (3) performed an economic analysis of the high volume production of each pottant in order to estimate the large volume selling price (EVA, EPDM, aliphatic urethane, PVC plastisol, and butyl acrylate); (4) initiated an experimental corrosion protection program to determine if metal components could be successfully protected by encapsulation; (5) began an investigation to determine the maximum temperature which can be tolerated by the candidate pottant material in the event of hot spot heating or other temperature override; (6) continuation of surveys of potentially useful outer cover materials; and (7) continued with the accelerated artificial weathering of candidate encapsulation materials. Study results are presented. (WHK)

8750 **(DOE/JPL/954589—80/9) Development of a process for high capacity arc heater production of silicon for solar arrays. Final technical report.** (Westinghouse Electric Corp., Trafford, PA (USA). Power Circuit Breaker Div.). 1979. Contract NAS-7-100-954589. 240p. NTIS, PC A11/MF A01.

Progress on a program to develop a high temperature silicon production process using existing electric arc heater technology is reported. Silicon tetrachloride and a reductant, liquid sodium, are injected into an arc heated mixture of hydrogen and argon. Under these high temperature conditions, a very rapid reaction occurs and proceeds essentially to completion, yielding silicon and gaseous sodium chloride. Techniques for high temperature separation and collection of the molten silicon were developed using standard engineering approaches. The experimental verification system for the production of silicon via the arc heater-sodium reduction of $SiCl_4$ was designed, fabricated, installed, and operated. Each of the attendant subsystems was checked out and operated to insure performance requirements. These subsystems included: the arc heaters/reactor, cooling water system, gas system, power system, Control and Instrumentation system, Na injection system, $SiCl_4$ injection system, effluent disposal system and gas burnoff system. Prior to introducing the reactants (Na and $SiCl_4$) to the arc heater/reactor, a series of gas only-power tests was conducted to establish the operating parameters of the three arc heaters of the system. Following the successful completion of the gas only-power tests and the readiness tests of the sodium and $SiCl_4$ injection systems, a shakedown test of the complete experimental verification system was conducted.

8751 **(DOE/JPL/954852—T2) Defect structure of EFG silicon ribbon.** Strunk, H.; Cunningham, B.; Ast, D. (Cornell Univ., Ithaca, NY (USA)). Dec 1980. Contract NAS-7-100-954852. 13p. NTIS, PC A02/MF A01.

The defect structure of EFG ribbons has been studied using EBIC, TEM and HVEM. By imaging the same areas in EBIC and HVEM a direct correlation between the crystallographic nature of defects and their electrical properties has been obtained. Partial dislocations at coherent twin boundaries may or may not be electrically active. Since no microprecipitates were observed at these dislocations it is likely that the different electrical activity is a consequence of the different dislocation core structures. Second order twin joins were observed which followed the same direction as the coherent first order twins normally associated with EFG ribbons. These second order twin joins are in all cases stronly electrically active. EFG ribbons contain high concentrations of carbon. Since no evidence of precipitation was found with TEM it is suggested that the carbon may incorporated into the higher order twin boundaries now known to exist in EFG ribbons.

8752 **(DOE/JPL/954868—80/9) Automated array assembly. Phase II. Final report, October 1977-December 1979.** D'Aiello, R.V. (RCA Labs., Princeton, NJ (USA)). Oct 1980. Contract NAS-7-100-954868. 260p. NTIS, PC A12/MF A01.

The philosophy of this project was to establish an experimental process line starting with 3-in.-diameter silicon wafers and consisting of junction formation using $POCl_3$ gaseous diffusion, screen-printed thick-film metallization, reflow solder interconnect, and double-glass lamination panel assembly. This experimental production line produced a sufficient number of solar cells to demonstrate the technological readiness of each of those process steps. Variations (of each process) were made to set limits on the usable range of each process step and to determine the interaction with adjoining steps. Inspections, measurements, and tests were included to determine the output requirement characteristics of each step, obtain statistical variations, and evaluate the performance of the solar cells and panels. A description of this work, which was conducted from October 1977 through December 1978, is given. This was followed by an 18-month study in which three manufacturing sequences synthesized from the previous work and from studies conducted by other participants in the LSA program were exercised. The objectives were to assess the compatibility between process steps for each sequence, to generate sufficient data for comparative SAMICS cost analysis, and to make recommendations of the suitability of one or more of these sequences for the large-scale automated production of solar cells within the cost goal of $0.70/pW. The detailed experimental results of this study are described, followed by SAMICS cost analysis, recommendations, and conclusions.

8753 **(DOE/JPL/955079—80/1) Development of simplified process for environmentally resistant cells. Final report.** King, W.J. (Kinetic Coatings, Inc., Burlington, MA (USA)). Dec 1980. Contract NAS-7-100-955079. 168p. NTIS, PC A08/MF A01.

A program to develop a simple, foolproof, all-vacuum solar cell manufacturing process which can be completely automated and which results in medium efficiency cells which are inherently environmentally resistant is described. All components of the completed cells are integrated into a monolithic structure with no material interfaces. The exposed materials (Si, Al_2O_3, Al, Ni) are all resistant to atmospheric attack and the junction, per se, is passivated to pre-

vent long term degradation. Such cells are intended to be incorporated into a simple module consisting basically of a press-formed metallic superstructure with a separated glass cover for missile, etc., protection. A 5 cm x 5 cm test cell configuration was designed in which the various efficiency loss factors were adjusted to yield a 10% AMI cell. Each of the cell elements was individually optimized for combination with the others. The basic cell consists of alloyed front (Al) and back (Ag plus Ni) contacts, a multi-purpose (AR, hermetic seal, implantation oxide) front surface coating of Al_2O_3, and an implanted front junction. Implantation damage annealing and contact alloying are carried out in a simple one step thermal treatment at 870°C using a resistance heated furnace in vacuum. The use of non-analyzed and semi-analyzed beams for fabricating these cells was developed by KCI. A final lot of 50 cells made using the semi-analyzed beam method had an average efficiency of 10.4% at AMI (28 +- 1°C). An economic analysis predicts a manufacturing cost of $.45/peak-watt for these cells using a one machine automatic method.

8754 **(DOE/JPL/955342—79/2) Development of Megasonic cleaning for silicon wafers. Final report.** Mayer, A. (RCA Solid State Div., Somerville, NJ (USA); RCA Labs., Princeton, NJ (USA)). Sep 1980. Contract NAS-7-100-955342. 97p. NTIS, PC A05/MF A01.

The major goals to develop a cleaning and drying system for processing at least 2500 three-in.-diameter wafers per hour and to reduce the process cost were achieved. The new system consists of an ammonia-hydrogen peroxide bath in which both surfaces of 3/32-in.-spaced, ion-implanted wafers are cleaned in quartz carriers moved on a belt past two pairs of Megasonic transducers. The wafers are dried in the novel room-temperature, high-velocity air dryer in the same carriers used for annealing. A new laser scanner was used effectively to monitor the cleaning ability on a sampling basis. The following factors contribute to the improved effectiveness of the process: (1) recirculation and filtration of the cleaning solution permit it to be used for at least 100,000 wafers with only a relatively small amount of chemical make-up before discarding; (2) uniform cleanliness is achieved because both sides of the wafer are Megasonically scrubbed to remove particulate impurities; (3) the novel dryer permits wafers to be dried in a high-velocity room-temperature air stream on a moving belt in their quartz carriers; and (4) the personnel safety of such a system is excellent and waste disposal has no adverse ecological impact. With the addition of mechanical transfer arms, two systems like the one developed will produce enough cleaned wafers for a 30-MW/year production facility. A projected scale-up well within the existing technology would permit a system to be assembled that produces about 12,745 wafers per hour; about 11 such systems, each occupying about 110 square feet, would be needed for each cleaning stage of a 500-MW/year production facility.

8755 **(DOE/JPL/955696—80/3) Laser annealing of ion implanted CZ silicon for solar cell junction formation.** Katzeff, J.S. (Lockheed Missiles and Space Co., Sunnyvale, CA (USA)). Jan 1981. Contract NAS-7-100-955696. 30p. NTIS, PC A02/MF A01.

Results on a contract to evaluate the merits of large spot size pulsed laser annealing of ion implanted silicon wafers for junction formation of solar cells are presented. Three inch diameter cells were fabricated for reference by furnace annealing of the ion implanted wafers. Conversion efficiencies on these cells ranged from 12.3% to 14.3%, with and without a BSF. Scaled-up size cells, from 2 x 2 cm to 2 x 4 cm, were fabricated using a two-step 25% overlap pulsed laser annealing process. Conversion efficiencies up to 15.4% were achieved. Pulsed laser annealing of textured surface wafers proved unacceptable based on the subpar electrical performances of fabricated 2 x 2 cm and 2 x 4 cm cells. Further laser annealing work using textured surfaces has been discontinued. SIMS profiling of ^{11}B and/or $^{49}BF_2$ ion implanted species for back surface field followed by pulse annealing, both by electron beam and laser, revealed that additional work is required for optimization. The process verification phase of the contract was initiated for small (2 x 2 cm) and large (3 in. dia) cells using the surviving processing candidates showing best promise. A high throughput laser system was conceptualized which will accommodate three (3) inch diameter wafers at a rate of one per second.

8756 **(DOE/JPL/955699—80-01) Process development for automated solar cell and module production. Task 4. Automated array assembly. Quarterly report No. 1.** Hagerty, J.J. (MB Associates, San Ramon, CA (USA)). 15 Oct 1980. Contract NAS-7-100-955699. 40p. NTIS, PC A03/MF A01.

Work has been divided into five phases. The first phase is to modify existing hardware and controlling computer software to: (1) improve cell-to-cell placement accuracy, (2) improve the solder joint while reducing the amount of solder and flux smear on the cell's surface, and (3) reduce the system cycle time to 10 seconds. The second phase involves expanding the existing system's capabilities to be able to reject broken cells and make post-solder electrical tests. Phase 3 involves developing new hardware to allow for the automated encapsulation of solar modules. This involves three discrete pieces of hardware: (1) a vacuum platen end effector for the robot which allows it to pick up the 1' x 4' array of 35 inter-connected cells. With this, it can also pick up the cover glass and completed module, (2) a lamination preparation station which cuts the various encapsulation components from roll storage and positions them for encapsulation, and (3) an automated encapsulation chamber which interfaces with the above two and applies the heat and vacuum to cure the encapsulants. Phase 4 involves the final assembly of the encapsulated array into a framed, edge-sealed module completed for installation. For this we are using MBA's Glass Reinforced Concrete (GRC) in panels such as those developed by MBA for JPL under contract No. 955281. The GRC panel plays the multiple role of edge frame, substrate and mounting structure. An automated method of applying the edge seal will also be developed. The final phase (5) is the fabrication of six 1' x 4' electrically active solar modules using the above developed equipment. Progress is reported. (WHK)

8757 **(DOE/JPL/955699—81/02) Process development for automated solar cell and module production. Task 4: automated array assembly. Quarterly report No. 2.** Hagerty, J.J. (MB Associates, San Ramon, CA (USA)). 15 Jan 1981. Contract NAS-7-100-955699. 20p. NTIS, PC A02/MF A01.

Installation of the cell preparation station into its new enclosure is now complete and operation verification tests have been performed. The detailed layout drawings of the Automated Lamination Station have been produced and construction has begun. All major and most minor components have been delivered by vendors. The station framework has been built and assembly of components is underway. The final drawings for the Automated Vacuum Chamber are being completed and the first in-house components are being fabricated.

8758 **(DOE/TIC—11386) Computer modelling of amorphous materials for photovoltaic conversion. Eighth quarterly and second annual report.** (Argonne National Lab., IL (USA)). 30 Sep 1980. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01.

Progress on modelling the electronic structure of pure and hydrogenated amorphous silicon is reported. (WHK)

8759 **(DOE/TIC—11387) Computer modelling of amorphous materials for photovoltaic conversion. Seventh quarterly progress report.** (Argonne National Lab., IL (USA)). 30 Jun 1980. Contract W-31-109-ENG-38. 27p. NTIS, PC A03/MF A01.

An accumulation of experimental results shows that amorphous silicon prepared by various methods may contain as much as 40 at. % of hydrogen, and that the optimum material for photovoltaic devices contains 10 to 15 at. % hydrogen. It is also becoming evident that the hydrogen atoms are incorporated in at least two qualitatively different ways: (1) convalently bound to Si atoms that are otherwise part of the normal random network, and (2) attached to Si atoms that are somehow associated with defects in the network whose scale is considerably greater than atomic dimensions. A structural model of the first kind of incorporation, which is in fairly good agreement with recent neutron diffraction data, is described.

8760 **(DSE—4042-T34) Low cost sprayed CdTe solar cell research. Second quarterly report, November 15, 1979-February 14, 1980.** Sienkiewicz, P.; Lis, S.; Serreze, H.B.; Entine, G. (Radiation Monitoring Devices, Inc., Watertown, MA (USA)). Mar 1980. Contract EG-77-C-01-4042. 20p. NTIS, PC A02/MF A01.

A comprehensive series of experiments was performed with the aim of optimizing parameters in the chemical spray deposition (CSD) of CdTe thin films. Two approaches have shown great promise. X-ray diffraction analysis has shown that CdTe can be produced from solutions containing $CdCl_2$ and $(NH_4)TeO_4$ with either hydrazine dihydrochloride or oxalic acid as the reducing agent. Films produced from the oxalic acid experiments have yielded encouraging infrared scans, and as a result this approach has received the most effort. In addition, good quality, photoconductive, CdS films have been produced via traditional methods and characterized using optical and electrical measurements. Overall film uniformity for both CdS and CdTe has been improved by the installation of a stainless steel, gravity fed, spray nozzle and mechanical linkage.

8761 **(EUR—6934-EN) GaAs-(GaAl) as solar cells to be used under concentrated solar light condition.** Fabri, G.; Fiorito, G. (Centro Informazioni Studi Esperienze, Milan (Italy)). 1980. 37p. NTIS, PC A03/MF A01.

A LPE facility for growing GaAs-GaAlAs epitaxial structures suitable for solar cells was designed and constructed. This facility allows growths on substrates up to 4 cm^2 in area and the use of solutions for several growths. After an investigation on GaAlAs and dopant phase diagrams, based on thermodynamic considerations, the growth critical parameters were set-up. A simple model analysis on the cell behavior allowed to identify the fundamental characteristics of both GaAs-GaAlAs structures and single layers. In accordance with such evaluations, GaAs-GaAlAs structures were grown and evaluated by device assessment. The obtained results evidenced the possibility of growing GaAs and GaAlAs layers with composition, doping and electric characteristics fitting solar cells.

8762 **(IDO—10088(Vol.1)) Design report: small-scale fuel alcohol plant.** (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 130p. NTIS, PC A07/MF A01.

The objectives of the report are to (a) provide potential alcohol producers with a reference design and (b) provide a complete, demonstrated design of a small-scale fuel alcohol plant. This report describes a small-scale fuel alcohol plant designed and constructed for the DOE by EG & G Idaho, Inc., an operating contractor at the Idaho National Engineering Laboratory. The plant is reasonably complete, having the capability for feedstock preparation, cooking, saccharification, fermentation, distillation, by-product dewatering, and process steam generation. An interesting feature is an instrumentation and control system designed to allow the plant to run 24 hours per day with only four hours of operator attention. Where possible, this document follows the design requirements established in the DOE publication Fuel From Farms, which was published in February 1980. For instance, critical requirements such as using corn as the primary feedstock, production of 25 gallons of 190 proof ethanol per hour, and using batch fermentation were taken from Fuel From Farms. One significant deviation is alcohol dehydration. Fuel From Farms recommends the use of a molecular sieve for dehydration, but a preliminary design raised significant questions about the cost effectiveness of this approach. A cost trade-off study is currently under way to establish the best alcohol dehydration method and will be the subject of a later report. Volume one contains background information and a general description of the plant and process.

8763 **(IDO—10088(Vol.2)) Design report small-scale fuel alcohol plant. Volume II. Detailed construction information.** (EG and G Idaho, Inc., Idaho Falls (USA)). Dec 1980. Contract AC07-76ID01570. 313p. NTIS, PC A14/MF A01.

The objectives of the report are to (a) provide potential alcohol producers with a reference design and (b) provide a complete, demonstrated design of a small-scale fuel alcohol plant. This report describes a small-scale fuel alcohol plant designed and constructed for the DOE by EG & G Idaho, Inc., an operating contractor at the Idaho National Engineering Laboratory. The plant is reasonably complete, having the capability for feedstock preparation, cooking, saccharification, fermentation, distillation, by-product dewatering, and process steam generation. An interesting feature is an instrumentation and control system designed to allow the plant to run 24 hours per day with only four hours of operator attention. Where possible, this document follows the design requirements established in the DOE publication Fuel From Farms, which was published in February 1980. For instance, critical requirements such as using corn as the primary feedstock, production of 25 gallons of 190 proof ethanol per hour, and using batch fermentation were taken from Fuel From Farms. One significant deviation is alcohol dehydration. Fuel From Farms recommends the use of a molecular sieve for dehydration, but a preliminary design raised significant questions about the cost effectiveness of this approach. A cost trade-off study is currently under way to establish the best alcohol dehydration method and will be the subject of a later report. Volume two includes equipment and instrumentation data sheets, instrument loop wiring diagrams, and vendor lists.

8764 **(IDO—10088(Vol.3)) Design report small-scale fuel alcohol palnt. Volume III. Drawings.** (EG and G Idaho, Inc., Idaho Falls (USA)). Dec 1980. Contract AC07-76ID01570. 170p. NTIS, PC A08/MF A01.

The objectives of the report are to (a) provide potential alcohol producers with a reference design and (b) provide a complete, demonstrated design of small-scale fuel alcohol plant. This report describes a small-scale fuel alcohol plant designed and constructed for the DOE by EG & G Idaho, Inc., an operating contractor at the Idaho National Engineering Laboratory. The plant is reasonably complete, having the capability for feedstock preparation, cooking, saccharification, fermentation, distillation, by-product dewatering, and process steam generation. An interesting feature is an instrumentation and control system designed to allow the plant to run 24 hours per day with only four hours of operator attention. Where possible, this document follows the design requirements established in the DOE publication Fuel From Farms, which was published in February 1980. For instance, critical requirements such as using corn as the primary feedstock, production of 25 gallons of 190 proof ethanol per hour, and using batch fermentation were taken from Fuel From Farms. One significant deviation is alcohol dehydration. Fuel From Farms recommends the use of a molecular sieve for dehydration, but a preliminary design raised significant questions about the cost effectiveness of this approach. A cost trade-off study is currently under way to establish the best alcohol dehydration method and will be the subject of a later report. This volume contains the equipment and construction drawings used to build the small-scale ethanol plant. The design in this volume represents the design at completion of construction and before continuous production began.

8765 **(LBL—11924) Phloem exudation studies in selected woody trees.** Costello, L.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 154p. NTIS, PC A08/MF A01.

Thesis.

Chelating agents, particularly EDTA, were tested for their effectiveness in enhancing the exudation of phloem sugars from selected woody tree species. Of the species selected, Fraxinus uhdei (Evergreen Ash) proved most useful for exudation studies. Experiments using ^{14}C labelled, excised leaflets of F. uhdei demonstrated that exudation was enhanced approximately 9-fold by a 2.0 mM EDTA treatment. An analysis of labelled products in the treatment solution showed that over 90% of label appeared in oligosaccharides and sucrose. These findings suggested that the sugars released into EDTA treatment solutions were principally derived from phloem sieve elements. Electron microscope studies of the fine structure of sieve plate pores after treatment with EDTA or H_2O showed substantially less callose appearing in sieve plates of leaflets treated with EDTA. It was proposed that EDTA enhances exudation by inhibiting or reducing callose formation in sieve plate pores. Subsequent experiments demonstrated that EDTA was effective in promoting exudation from whole plant specimens of F. uhdei as well as from excised leaflets. (MHR)

8766 **Ultra high efficiency thin silicon p-n junction solar cells using reflecting surfaces.** Spitzer, M.; Shewchun, J.; Vera, E.S.; Loferski, J.J. (Brown Univ, Providence, RI). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 375-380(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

The theoretical upper limit of the efficiency of silicon p/n junction solar cells is calculated for a cell which incorporates minority carrier mirrors and optical mirrors on both the front and back boundaries of the active part of the device. The two optical mirrors provide optical confinement and greatly reduce the thickness of the cell for optimum performance. If the cells are thin enough, the minority carrier mirrors reduce the saturation current and increase the open circuit voltage. The calculations of the efficiency versus cell thickness show that efficiencies of the order of 27% are possible for silicon cells having a thickness of only 15 μm. Ways to realize the optical confinement and the minority carrier mirrors are discussed. 8 refs.

8767 **(PNL-SA—8133) Overview of biomass thermochemical conversion activities funded by the biomass energy systems branch of DOE.** Schiefelbein, G.F.; Sealock, L.J. Jr.; Ergun, S. (Battelle Pacific Northwest Labs., Richland, WA (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1979. Contract AC06-76RL01830. 11p. (CONF-791069—5). NTIS, PC A02/MF A01.

From 6. annual conference on energy; Rolla, MO, USA (16 Oct 1979).

The US Department of Energy (DOE) is actively involved in the development of renewable energy sources through research and development programs sponsored by the Biomass Energy Systems Branch. The overall objective of the thermochemical conversion element of the Biomass Energy Systems Program is to develop competitive processes for the conversion of renewable biomass resources into clean fuels and chemical feedstocks which can supplement fuels from conventional sources. An overview of biomass thermochemical conversion projects sponsored by the Biomass Energy Systems Branch is presented in this paper.

8768 **(SAN—3045-3) Chemical vapor deposition of thin-film polycrystalline Si for low-cost solar cells. Third quarterly technical progress report, February 2, 1980-May 2, 1980.** Ruth, R.P.; Simpson, W.I.; Yang, J.J.J.; Moudy, L.A.; Johnson, R.E. (Rockwell International Corp., Anaheim, CA (USA). Electronic Devices Div.). May 1980. Contract AC03-79ET23045. 107p. NTIS, PC A06/MF A01.

The program has emphasized a study of the transport properties of p-type polycrystalline Si films as functions of average grain size and impurity doping concentration. Preliminary investigations of nucleation and early-stage growth phenomena in such films have also been carried out to provide improved understanding of the fundamental properties of the films that limit photovoltaic performance and thus to establish a good technical basis for subsequent attempts to achieve improved performance in solar cells using such films. Also, the study of transport properties was extended to n-type polycrystalline Si films. The transport studies have involved preparation of sets of B-doped p-type and P-doped n-type polycrystalline films grown simultaneously by SiH_4 pyrolysis in H_2 on polycrystalline high-purity alumina substrates in a range of average grain sizes ($\sim$ 1 μm to $\sim$ 125 μm) and with a range of impurity doping concentrations from $\sim 10^{15}$ to $>10^{20}$ cm^{-3}, primarily at $\sim$ 985°C. The p-type films have been characterized in detail by measurements of transport properties of a function of sample temperature in the range 77 to 420°K. The results of these investigations are described in detail. In particular, the height of the intergrain barrier in polycrystalline Si as a function of doping concentration as well as average grain size has been determined, and comparisons of these experimental results with the predictions of the grain-boundary trapping model for conduction in polycrystalline Si are made. Sets of CVD polycrystalline and single-crystal films have been used for the fabrication of solar cells, utilizing both vapor-grown and P-diffused junctions. The experimental solar cell structures have had generally poor photovoltaic properties, in most instances for easily diagnosed reasons.

8769 **(SAND—80-7073) Near-term implementation of projection cost reductions for photovoltaic concentrator array. Final report, 18 December 1978-7 January 1980.** Grenon, L. (Motorola, Inc., Phoenix, AZ (USA). Solar Operations). Dec 1980. Contract AC04-76DP00789. 43p. NTIS, PC A03/MF A01.

A chronological review of the process sequence is presented. Contained in the presentation is an explanation of each process step and its production readiness status. Some of the processes used have a long history of manufacturability and are included in the discussion to maintain process continuity. Other processing features were specifically considered in this program for incorporating into this process sequence. These include (1) an evaluation of use of thin silicon substrates (7 mil), (2) selection of a wax material capable of protecting selected surfaces of the solar cell from attack by various chemical etches during processing, (3) evaluation of ion implantation processes and annealing techniques, (4) development of a fine surface texturing process for improved absorbtion of incident illumination as well as, (5) provision for subsequent development of fine line front surface metallization patterning, (6) optimization of the metallization processes, and (7) a determination of those parameters that must be tested in order to determine the quality of a finished concentrator solar cell. Additionally, processes that have evolved during the contract period that have direct application to satisfying a near-term cost effective process sequence have been evaluated. These include plasma etching, plasma patterning, and evaluation of a lower cost nickel-copper metallization process.

8770 **(SAND—80-7074) Analysis of the Mount Laguna photovoltaic cell failure.** (BDM Corp., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 119p. NTIS, PC A06/MF A01.

The purpose of this analysis is to provide photovoltaic system design and field engineers with an understanding of the primary factors which can cause individual P/V cells in a module or an array to be forced into reverse bias and eventual failure and to provide guidelines for adequate protection of the array. The analysis was performed to address the specific problem of the failure of P/V cells occurring at the Mt. Laguna, California P/V flat plate array. The P/V cell transient analysis program, PV-TAP, is used in order to develop an analytical model of the cell failure mechanism. The primary mode of cell failure identified is outgassing which eventually produces cracked cells. The analysis begins by identifying the potential factors which can cause a P/V cell to go into reverse bias. Then each of these factors is evaluated in a module of 40 individual cells and in a string of 14 modules for the full range of the module and string operating voltages. The next step in the analysis is to develop the relationship between reverse bias and P/V cell temperature. The final temperature assessment will be made for the cell with the worst reverse bias conditions. The other cells will be at lower reverse bias or forward biased. Therefore, to a first approximation, they can be considered to remain near their normal operating temperature and will not significantly affect the thermal flow of the reverse biased cell. The final step in the analysis is to combine the causes of reverse bias with cell heating due to reverse bias and the effects of bypass diodes. This process allows the identification of the failure mechanisms. Once the failure mechanisms are identified, protective measures are devised to eliminate these failures. (WHK)

8771 **(SAND—80-7138) Development of a combined photovoltaic/thermal linear receiver for a parabolic trough concentrator.** (General Electric Co., Philadelphia, PA (USA)). Dec 1980. Contract AC04-76DP00789. 66p. NTIS, PC A04/MF A01.

The development of a novel receiver design for a linear focus concentrator is discussed. The design concept described employs a pair of nested glass tubes. A specially configured inner borosilicate glass tube functions as the mounting surface for the solar cell circuit in this dual focus receiver geometry. This inner tube, which is capped at each end to provide an interior dead air space, is inserted within a 2 inch ID glass pipe which is part of the Corning Pyrex beaded pressure process piping system. The selected receiver coolant, which is designated as Synfluid (2 centistokes kinematic viscosity), is circulated through the outer glass pipe in direct contact with the solar cell circuit active area. The concentrated ir-

radiance from the parabolic trough impinges on the outer glass pipe and is optically transmitted through the clear synthetic mineral oil to the solar cell circuit. Two prototype receivers of this design were fabricated and assembled. One of these units was installed in the Phase I Sea World trough and subjected to a series of characterization tests to evaluate both thermal and electrical performance; results are presented and discussed.

8772 **(SAND—80-7139) Development of a photovoltaic concentrator cell assembly for use in point focus systems. Final report.** (General Electric Co., Philadelphia, PA (USA)). Dec 1980. Contract AC04-76DP00789. 66p. NTIS, PC A04/MF A01.

A solar cell mount assembly for use in a Fresnel lens point-focus concentrator system has been developed. This assembly uses a GE-patented direct bonded copper-on-alumina insulator to provide the required electrical isolation with a thermal resistance of less than 0.2°C/watt between the solar cell junction and the interface of the mount with the module baseplate. High lead solder, Indalloy 151, is used to attach the cell contacts to the direct-bonded copper conductors and to attach the insulator subassembly to a copper heat spreader which provides the centrally located mounting stud for the assembly. This solder composition has demonstrated superior fatigue resistance, when compared to 60 percent tin solder, when subjected to thermal cycling in a bimetal sandwich laminate. Development cell mounts of this design have been subjected to a thermal cycling test exposure, consisting of 100 cycles between the extremes of -30 and +50°C followed by 100 cycles between the extremes of +50 to +150°C, without measurable changes in the thermal resistance. One thousand cell mounts of this design have been assembled and delivered to Sandia for further evaluation.

8773 **(SERI/PR—8062-1-T3) Zn_3P_2 as a new low cost high efficiency solar cell material. Second quarterly report, December 1, 1978-February 28, 1979.** Catalano, A. (Delaware Univ., Newark (USA). Inst. of Energy Conversion). 1979. Contract AC02-77CH00178. 31p. NTIS, PC A03/MF A01.

Developmental work has been performed on both the isostructural, n-(Cd/sub x/Zn/sub 1-x/)$_3$ P_2/p-Zn_3P_2 and non-isostructural, ZnS/Zn_3P_2 heterojunction devices. Development of the isostructural alloy devices consisted of the fabrication, testing and analysis of epitaxial n-Cd_3P_2/p-Zn_3P_2 devices and the experimental assessment of several methods for the vapor growth of alloy crystals. Analysis of the I-V characteristics of the Cd_3P_2/Zn_3P_2 devices indicate a diffusion voltage which varies from 0.445 eV at 212°K to 0.22 eV at 86°K. The decrease in diffusion voltage on the temperature is consistent with the gradual increase in the distance of the Fermi level from the valence band in Zn_3P_2 as carrier freeze-out occurs. The diode factor A also increases to 2.5 over the same temperature range indicating the increased role of interface over bulk recombination at the lower temperature. The value of 0.445 eV obtained for the Cd_3P_2/Zn_3P_2 structure compares favorably with a simple band model of the device and indicates that heterojunctions of the alloy should yield devices with sufficiently large diffusion voltage and open circuit voltage to provide useful photovoltaic devices. ZnS/Zn_3P_2 heterojunctions with ZnS resistivities between 10^8-1 Ω-cm were fabricated and tested. The I-V characteristics were poor and were dominated by the series resistance of the Zn_3P_2. Analysis of the devices indicate a diffusion voltage of 0.67 eV, but few devices showed any photovoltaic effect.

8774 **(SERI/PR—8062-1-T4) Zn_3P_2 as an improved semiconductor for photovoltaic solar cells. Third quarterly report, March 1-May 31, 1979.** Catalano, A. (Delaware Univ., Newark (USA). Inst. of Energy Conversion). 1979. Contract AC02-77CH00178. 27p. NTIS, PC A03/MF A01.

Heterojunctions of the type p-Zn_3P_2/n-(Cd/sub x/Zn/sub 1-x/)$_3P_2$ were fabricated and tested by interdiffusing the end members of the alloy system. Grading of the junction was evidenced by electron microprobe analysis of the metallurgical junction. The current-voltage dependence of the diodes has been examined as a function of temperature and a simple heterojunction model yields a diffusion voltage of 0.64 eV at room temperature, only slightly less than Schottky barrier devices and ~ 0.2 eV greater than that obtained with abrupt junction devices. The optical absorption constant of several alloys has been examined and the expected decrease in Eg with addition of cadmium is found. The bandgap at the p-n transition is estimated to be near 1.1 eV. The dependence of J/sub sc/ on grid width of Schottky barrier devices has been compared to theory and the effective diffusion length in thin Zn_3P_2 films calculated. The data suggest a junction collection efficiency on the order of 50%. The minority carrier diffusion length has also been measured by EBIC and laser scanning on the same sample and the results compared. The front wall spectral response method has also been used to determine L/sub n/. The range of minority carrier diffusion lengths observed by all methods is between 0.5 μm to 4 μm. On the basis of these values, current densities of between 10 to 23 mA/cm² are expected for a conventional backwall device and 3-16.7 mA/cm² for a Schottky barrier grid device. The fabrication of a novel ion plated substrate useful for the high temperature growth of Zn_3P_2 films is also reported.

8775 **(SERI/PR—8104-3-T2) Low cost, sprayed CdTe solar cell research. First annual progress report, August 15, 1979-August 14, 1980.** Serreze, H.B.; Squillante, M.; Lis, S.; Turcotte, R.; Talbot, M.; Entine, G. (Radiation Monitoring Devices, Inc., Watertown, MA (USA)). Sep 1980. Contract AC02-77CH00178. 38p. NTIS, PC A03/MF A01.

This program is examining techniques to produce sprayed CdTe solar cells by utilizing experimental methods similar to those previously developed to produce device quality CdS and CdSe thin films. The existing technology is being extended by making use of inorganic tellurium salts and by appropriately modifying the process parameters. Using this approach films of CdTe were spray deposited. Furthermore, the spray solution is very stable and the process is reproducible. Preliminary Schottky barrier solar cell devices have shown very encouraging AMl photovoltaic behavior. For devices of ~ 0.04 cm² area, V/sub oc/ values in excess of 550 mV, J/sub sc/ values of over 13 mA/cm², and efficiencies of up to 2% have been observed. Large area devices have also been made, but they presently appear series resistance limited.

8776 **(SERI/PR—9079-1-T3) Structural and electronic studies of defects in amorphous silicon. Technical progress report, September-November, 1980.** Street, R.A. (Xerox Palo Alto Research Center, CA (USA)). 22 Dec 1980. Contract AC02-77CH00178. 67p. NTIS, PC A04/MF A01.

Separate abstracts were prepared for the two sections included. (WHK)

8777 (SERI/PR—9079-1-T3, pp 50p Paper 1) **Defect states in doped and compensated a-Si:H.** Street, R.A.; Biegelsen, D.K.; Knights, J.C. 22 Dec 1980.

In Structural and electronic studies of defects in amorphous silicon. Technical progress report, September-November, 1980.

Luminescence, ESR, optical absorption, conductivity and composition data are measured on doped and compensated hydrogenated amorphous silicon. In material singly doped with boron or phosphorus, a variety of experiments indicate the introduction of a large defect density (up to 10^{18} cm^{-3}) of the dangling bond type. Compensation increases the luminescence efficiency, but the luminescence peak shifts strongly to lower energy. Compensation reduces the ESR resonance at g = 2.0055, but a broad resonance characteristic of a hole trap remains. We deduce that compensation reduces the dangling bond density, but introduces a new band of localized states above the valence band edge. We associate these new states with boron-phosphorus complexes whose origin is a chemical interaction occurring during deposition. The changes in dangling bond density with doping and compensation lead us to propose an auto compensation mechanism of defect formation. Also reported is the first observation of a metastable light-induced ESR signal in a-Si:H.

8778 (SERI/PR—9079-1-T3, pp 16p, Paper 2) **Photoconductivity of amorphous semiconductors.** Street, R.A. 22 Dec 1980.

In Structural and electronic studies of defects in amorphous silicon. Technical progress report, September-November, 1980.

An analysis of photoconductivity is presented for a material with a carrier mobility which decreases logarithmically with time.

The steady state and transient response is calculated, and it is shown that the model applies to hydrogenated amorphous silicon and other amorphous semiconductors. In a-Si:H the effective mobility is obtained from 10^{-6} to 1 sec. The recombination is of bimolecular type and the carrier density is almost independent of excitation intensity. A model for the time-dependent mobility is discussed.

8779 (SERI/PR—9171-1-T1) Low-cost silicon substrates by directional solidification. Third quarterly report, September 1-November 30, 1980. Schmid, F.; Khattak, C.P.; Basaran, M. (Crystal Systems, Inc., Salem, MA (USA)). Dec 1980. Contract AC02-77CH00178. 32p. NTIS, PC A03/MF A01.

Plane front solidification and refining of metallurgical grade silicon (Mg-Si) by the Heat Exchanger Method (HEM) were examined experimentally and theoretically. Better crystallinity was obtained from the Mg-Si if melt turbulence occurs during solidification. This was also verified by theoretical analyses. Experimental measurements indicate that vacuum purification of Mg-Si can be improved by increasing the holding time under vacuum, by using silica powder and/or increasing its amount. It has been shown that simple directional solidification by HEM of commercially available Mg-Si can produce material for 7.2% conversion efficiency solar cells.

8780 (SERI/PR—9318-1-T1) Optimization of transparent electrode for solar cells. Technical progress report, 15 September-15 December, 1980. Gordon, R.G. (Harvard Univ., Cambridge, MA (USA)). 1980. Contract AC02-77CH00178. 9p. NTIS, PC A02/MF A01.

Solar cells usually need a surface layer which simultaneously transmits almost all of the incident sunlight, and also conducts electricity very well. Such layers, called transparent electrodes, must also be strong, stable to weathering and sunlight, inexpensive, nontoxic, non-polluting, and composed of sufficiently abundant materials. This long list of requirements is best met by a film of fluorine-doped tin oxide made by a new process. The current research has as its goal further improvements in the properties of this transparent electrode material. The first phase of the work is seeking to find out what mechanisms now limit the transparency and electrical conductivity of this material. It is suspected that certain chemical impurities, and also mechanical imperfections at boundaries between small grains in the films, may have deleterious effects. The second phase of the work will attempt to minimize those deleterious factors which are identified in the first phase. Then all the other experimental factors will be varied systematically to obtain the most transparent and electrically conductive films possible. Finally, some samples of optimal films will be made, under the best conditions obtained. Progress is summarized. (WHK)

8781 (SERI/TP—623-1045) Photoelectrosynthesis at semiconductor electrodes. Nozik, A.J. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1980. Contract AC02-77CH00178. 33p. (CONF-800827—4). NTIS, PC A03/MF A01.

From 3. international conference on photochemical conversion and storage of solar energy; Golden, CO, USA (3 Aug 1980).

The general principles of photoelectrochemistry and photoelectrosynthesis are reviewed and some new developments in photoelectrosynthesis are discussed. Topics include energetics of semiconductor-electrolyte interfaces(band-edge unpinning); hot carrier injection at illuminated semiconductor-electrolyte junctions; derivatized semiconductor electrodes; particulate photoelectrochemical systems; layered compounds and other new materials; and dye sensitization. (WHK)

8782 (SERI/TP—743-1027) Environmentel regulations: applicability to advanced photovoltaic concepts. Schaller, D.A. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1981. Contract AC02-77CH00178. 15p. (CONF-801171—1). NTIS, PC A02/MF A01.

From 7. national conference on energy and the environment; Phoenix, AZ, USA (30 Nov 1980).

Federal environmental, health, and safety programs related to the manufacturing of Cu_2S/CdS solar cells are discussed. Air quality, occupational health, water quality, solid and hazardous wastes, and occupational safety related to the fabrication of Cu_2S/CdS solar cells are discussed. (WHK)

8783 (SERI/TR—8041-2-T1) Plasma-assisted CVD of fluorinated, hydrogenated amorphous silicon. Final technical report, September 15, 1979-September 15, 1980. Coleman, J.H.; Hammes, J.P.; Wiesmann, H.J. (Plasma Physics Corp., Locust Valley, NY (USA)). 1980. Contract AC02-77CH00178. 30p. NTIS, PC A03/MF A01.

During the past year, approximately 300 large-area (400 cm^2) PIN hydrogenated amorphous silicon (a-Si:H) solar cells were fabricated and tested. a-Si:H PIN cells which were plasma deposited at 200° to 350° were found to have high internal currents (13mA/cm^2), whereas those which were deposited by CVD at 500° to 650°C had low internal currents. When corrected for optical losses in the top electrode, the internal quantum efficiency vs wavelength for the PIN cells indicated a peak value above 80% at about 525nm, which decreased monotonically to zero at about 725 nm. When the published values of RCA and EXXON were corrected similarly for optical loss, nearly identical values of internal quantum efficiencies were found. Calculations based on a model proposed by Cody et al of EXXON indicated that the depletion width was less than 0.4 microns for all PIN cells, thereby limiting junction efficiency in the red portion of the solar spectrum since the 1/e photon range exceeds this value. A novel inverted NIP cell was tested and found to have its maximum quantum response shifted to 625 nm. Also, an amorphous boron (a-B) layer deposited on a-Si:H to form a PIN heterojunction improved blue response and Voc. A combination of the red-responsive cells and the a-B heterojunction cells could raise efficiency to 8%.

8784 Polycrystalline Zn_3P_2 Schottky barrier solar cells. Bhushan, M.; Catalano, A. (Institute of Energy Conversion, University of Delaware, Newark, Delaware 19711). *Applied Physics Letters (U.S.);* **38**: No. 1, 39-41(1 Jan 1981).

Energy conversion efficiencies as high as 5.96% are reported on polycrystalline transparent magnesium Zn_3P_2 diodes, 0.7 cm^2 in area, tested under simulated AM1 illumination. The transparent Mg films with low sheet resistivities are obtained by dc sputtering. The effective minority-carrier diffusion length in Zn_3P_2 is estimated from spectral response measurements and correlates well with the measured short-circuit current. Loss analysis of the present cells shows a practical upper limit of 9% in conversion efficiency.

8785 Surface charge and specific ion adsorption effects in photoelectrochemical devices. Singh, P.; Singh, R.; Gale, R.; Rajeshwar, K.; DuBow, J. (Department of Electrical Engineering, Colorado State University, Fort Collins, Colorado 80523). XP-9-8002-9. *Journal of Applied Physics (U.S.);* **51**: No. 12, 6286-6291(Dec 1980).

The importance of specific ion adsorption and surface charge effects in the design and operation of photoelectrochemical (PEC) devices is demonstrated by experimental data on the n-GaAs/electrolyte and n-Si/electrolyte interface. The electrolyte chosen for the present study was an ambient temperature molten salt comprising mixtures of aluminum chloride and n-butyl pyridinium chloride in varying molar ratios. A direct correlation between specific adsorption effects and photovoltaic output parameters is presented for the n-GaAs PEC system. Evidence for specific adsorption of Cl^- ions in this system is found in the systematic shift observed in flat-band potentials V/sub fb/ towards negative values with increasing concentration of free Cl^- ions in the $AlCl_3$-BPC electrolyte. The magnitude of the slope of V/sub fb/ versus pCl (=-log[Cl^-]) plots [~0.13 V or 2(2.3kT/q) V] is consistent with that expected from Esin-Markov adsorption behavior. Anomalous PEC behavior is observed at the n-Si/$AlCl_3$-BPC interface brought about by modifications in electrostatics across the electrode/electrolyte interphasial region. These modifications arise from either specific adsorption effects or by electrodeposition of aluminum on the n-Si electrode surface. Either process results in a net lowering of the band structure in n-Si on the energy scale relative to the redox levels. An examination of literature data on high-efficiency PEC systems reveals that similar shifts in the relative positions of the semiconductor energy levels and redox energies may play an important role in ensuring a more favorable photoresponse than that predicted from idealized models.

8786 Operation of the semiconductor-insulator-semiconductor solar cell: Barrier height lowering through interface states. Spitzer, M.; Shewchun, J.; Burk, D. (Spire Corp., Patriots Park, Bedford, Massachusetts 02173). E(04-3)-1203. *Journal of Applied Physics (U.S.);* **51**: No. 12, 6399-6404(Dec 1980).

Previous studies have shown that the characteristics of the semiconductor-insulator-semiconductor (SIS) solar cell can be controlled by the thin interfacial layer. In this paper, we present the results of a theoretical investigation of the role of interface states at the SiO_2-Si interface in the ITO-SiO_2-Si SIS solar cell. A numerical solution of the governing transport equations yields the dependence of efficiency, short-circuit current, and open-circuit voltage on interface state density. It is shown theoretically that occupied acceptorlike interface state lower the barrier height and thus raise the dark saturation current while lowering the open-circuit voltage. Experimental results are presented which relate the saturation current to the process step which forms the interfacial layer and which support the model.

8787 Design considerations for high efficiency polycrystalline silicon MIS solar cells. Rajkanan, K.; Anderson, W.A. (Gen Instrum Corp, Hicksville, NY). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 386-390(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Cr-MIS solar cells have been fabricated on p-type wacker poly-Si substrates. Band to band tunneling and tunneling via surface states have been identified in these devices and the role of surface preparation has been determined. Experimentally determined current conduction mechanisms were used in computer simulation of these solar cells. The optimum process parameters and their sensitivity in determining conversion efficiency are identified. 8 refs.

8788 Current transport mechanisms of metal-polycrystalline silicon Schottky barrier solar cells. Hwang, W.; Yang, E.S.; Card, H.C.; Wu, C.M. (Columbia Univ, New York, NY). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 404-409(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

A description is given of the results of a theoretical study of the electrical and photovoltaic properties of metal-polycrystalline silicon contacts. An analysis of the dark behavior of these structures reveals that the current may be dominated either by majority carrier or by minority carrier transport, depending upon the conditions of Schottky barrier height and parameters which characterize the grain boundaries. Experimental verification of this theory is provided by the present results for Al-cast polysilicon contacts and by previously reported characteristics for thin films. The implications for solar cell parameters (open-circuit voltage, fill-factor, and conversion efficiency) are also discussed. 16 refs.

8789 Characterization of p^+nn^+ BSF silicon concentrator solar cells. Nasby, R.D.; Fossum, J.G. (Sandia Lab, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 419-422(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

The characteristics of high-efficiency p^+nn^+ BSF silicon concentrator solar cells are investigated experimentally and theoretically. Current-voltage characteristics and internal quantum efficiency data are used in conjunction with device analysis to characterize cell behavior, to evaluate physical parameters, and to indicate present limitations on cell performance. 8 refs.

8790 Low series resistance silicon photovoltaic cell for high intensity applications. Frank, R.I.; Goodrich, J.L.; Kaplow, R. (Microwave Assoc Inc, Burlington, Mass). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 423-430(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

A description is given of a silicon concentrator cell having a novel design which greatly reduces series resistance losses, so that the efficiency continues to increase with increasing intensity to incident intensities of 1000 suns. In this device, diffusions and metallizations are both embedded in deeply etched grooves normal to the cell surface, which are formed by anisotropic etching in /LT AN BR/110/RT AN BR/ silicon. As a result there is no current flow within the junction planes, and the surface area available for metallization is large compared to the obscured surface area. Efficiencies of 19-20% at 600 suns have previously been measured on small laboratory prototype cells. 10 refs.

8791 Effects of nonuniform illumination and temperature profiles on silicon solar cells under concentrated sunlight. Sanderson, R.W.; O'Donnell, D.T.; Backus, C.E. (Ariz State Univ, Tempe). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 431-436(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Two separate experiments were performed to determine the independent effects of either nonuniform illumination or nonuniform temperature distributions on the performance of silicon solar cells under concentrated sunlight. To find the effects of nonuniform temperature distributions, cells were exposed to uniform illumination levels but with known temperature profiles imposed upon the cell. The nonuniform illumination experiments were performed with the cells at a uniform temperature throughout the cell. The nonuniform illumination profiles included step changes of illuminated to unilluminated parts of the cell as well as continuously varying profiles across the geometry of the cell. 5 refs.

8792 Effects of nonuniform illumination on the performance of silicon concentrator solar cells. Garner, C.M.; Nasby, R.D. (Sandia Lab, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 437-442(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

In this study, solar cell performance has been computer modeled to account for the intensity distribution incident on the cell. The results from this model have been found to agree well with experimental data obtained on several n^+-p cells with conventional front grid patterns that were tested under uniform and nonuniform illumination profiles. Voltage drops in the diffused layer are found to produce most of the degradation of performance and the calculations demonstrate that this degradation can be reduced by decreasing the grid line separation and width. 6 refs.

8793 Cuprous oxide MIS solar cells. Wang, E.Y.; Trivich, D.; Komp, R.J.; Tzer-Fu, H.; Brinker, D.J. (Wayne State Univ, Detroit, Mich). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 458-461(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Cuprous oxide MIS solar cells were made with SiO_2 interfacial layers of thickness ranging from 10 to 100 A, and semi-transparent layers of Au, Cu, Ag and Al. Results from current-voltage measurements show that Au/SiO_2/Cu_2O MIS devices are ohmic in nature and have no photovoltaic effect. Ag/SiO_2/Cu_2O, Cu/SiO_2/Cu_2O and Al/SiO_2/Cu_2O exhibit rectifying and photovoltaic characteristics. Capacitance-voltage measurements indicate that the space charge region is approximately .5 μm wide. 12 refs.

8794 Investigation of Cu_2O solar cells. Olsen, L.C.; Addis, F.W.; Bohara, R.C. (Joint Cent for Grad Study, Richland, Wash). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 462-467(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

A discussion is presented of an approach used for Cu_2O substrate fabrication, electrical and optical properties of Cu_2O, photocurrent analysis and experimental results for Cu_2O solar cells. An AM1 photocurrent of 8.5 mA/cm^2 and AM1 efficiency of 1.8% has been achieved for Cu-Cu_2O MIS cells based on a tentatively identified I-layer of CuBr. Studies of MIS cells fabricated with an evaporated SiO_2 I-layer are discussed as well as preliminary results for ZnS/Cu_2O and ZnO/Cu_2O heterojunctions. 2 refs.

8795 **Thin film polycrystalline solar cells prepared by electrodeposition.** Shkedi, Z.; Rod, R.L. (Monosolar Inc, Inglewood, Calif). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 472-475(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Thin film polycrystalline CdTe photovoltaic cells were prepared by electrodeposition. It is shown that polycrystalline material can be grown at low temperatures. Crystallinity studies of the thin film CdTe material are reported. The first thin film polycrystalline homojunction CdTe cell is reported. I-V characteristics of homojunction and of Schottky barrier cells on electrodeposited CdTe are presented. 5 refs.

8796 **Low-cost conversion of polycrystalline silicon into sheet by HEM and FAST.** Khattak, C.P.; Schmid, F. (Cryst Syst Inc, Salem, Mass). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 484-487(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

The combination of Heat Exchange Method (HEM) and muti-wire Fixed Abrasive Slicing Technique (FAST) offers one of the lowest cost processes for conversion of polycrystalline silicon into sheet form--$14.87 per square meter add-on cost. The product is rectangular cross-section, single crystal wafer with low surface damage. Cubic crystals of 20 cm size weighing up to 16.3 kg have been solidified by HEM. Some of the significant developments in the HEM process were development of a graded crucible to prevent ingot cracking, vacuum processing to reduce argon costs and improved heat extraction through a hole in the bottom of the crucible. 10 refs.

8797 **Flat plate vs. concentrator solar photovoltaic cells: a manufacturing cost analysis.** Grenon, L.A.; Coleman, M.G. (Motorola Inc, Phoenix, Ariz). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 488-493(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

A manufacturing cost analysis for both flat plate and concentrator silicon solar cells has been performed. The cost of concentrator solar cells is shown to be a strong function of production volume which, in turn, is a strong function of the concentration level. Manufacturing of concentrator solar cells in a stand-alone factory would require enormous volumes of concentrator systems to be produced to allow major cost reductions to occur. The comanufacturing of both flat-plate and concentrator cells in the same factory and utilizing similar processes will allow rapid cost reductions for concentrator cells to occur. 4 refs.

8798 **Circuit design considerations for photovoltaic modules and systems.** Gonzalez, C.; Weaver, R. (Calif Inst of Technol, JPL, Pasadena). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 528-535(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

A program of module and array circuit-design studies has been carried out to improve the reliability of modules and to develop strategies for improving array system fault tolerance. Analyses to determine optimum element configuration and circuit design strategies, made with the use of a computer model that uses the measurable characteristics of cells and modules as input, are described and results are presented. Guidelines for implementing strategies to deal with specific module and array system circuit-design problems, involving use of series-paralleling and bypass diodes to reduce module and array system power losses resulting from anomalies, are offered. Several different power-loss conditions resulting from anomalies are considered. 1 ref.

8799 **Two modified single diode models for simulating solar cells with distributed series resistance.** Otterbein, R.T.; Evans, D.L. (Ariz State Univ, Tempe). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 574-579(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Two relatively simple models for simulating solar cells with appreciable internal resistances in the fingers or diffused region are presented. One model (a single parameter model) modulates the lumped series resistance with current in a manner predictable from known values of temperature and concentration. The second model (a double parameter model) utilizes a concentration and temperature dependent lumped series resistance and diode imperfection factor, but does not require current or voltage dependent parameters. 9 refs.

8800 **Fundamental limitations on silicon solar-cell efficiency.** Redfield, D. (RCA, Princeton, NJ). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 580-584(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

The fundamental physical mechanisms that have been thought to limit the efficiency of Si solar cells are reexamined, some are found inapplicable, and a new model is proposed to explain the large discrepancy between predicted and observed efficiencies. The new model is based on (i) the role of Auger processes in heavily doped material, and (ii) the effects of doping gradients in the diffused region. This model provides a unified explanation for the observed limits on both J/sub sc/ and V/sub oc/ due to contributions from both the base and diffused regions. 12 refs.

8801 **Theoretical limit efficiency of direct gap solar cells.** Spitzer, M.; Loferski, J.J.; Shewchun, J. (Brown Univ, Providence, RI). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 585-590(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

The theoretical upper limit conversion efficiency is calculated as a function of cell thickness and junction position for a homojunction solar cell made from a direct gap semiconductor in which homogeneously doped n- and p-regions are terminated by surfaces having zero surface recombination velocity and in which an optical mirror is incorporated on the surface opposite that on which light is incident. Most of the calculations are focused on $CuInSe_2$ with a portion of the effort devoted to GaAs. For $CuInSe_2$ cells, the principal conclusion is that the thickness at which optimum AM1 efficiency is obtained is somewhat less than 2 μm and that this efficiency is approximately 26%. 13 refs.

8802 **ZnO films and ZnO/CdTe heterojunctions prepared using spray pyrolysis.** Aranovich, J.A.; Fahrenbruch, A.L.; Bube, R.H. (Stanford Univ, Calif). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 633-634(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Using the essentially low cost technique of spray pyrolysis, highly transparent ZnO films with a resistivity as low as 10^{-3} ohm-cm have been produced by suitable control of deposition conditions and post-deposition annealing. A detailed structural, optical, electri-

cal and thermoelectrical characterization of these films has been made. The preparation of ZnO/CdTe heterojunctions by spray pyrolysis deposition of ZnO on single crystal p-type CdTe has been systematically investigated, and a consistent model involving control of forward currents by bulk and interface deep traps has been developed. 3 refs.

8803 **Optimization of a photovoltaic receiver for a parabolic trough concentrator.** Garner, C.M.; Biggs, F. (Sandia Lab, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 743-748(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

The overall efficiency of a photovoltaic solar collector depends on design parameters such as the position and shape of the receiver, the size of the solar cells and whether a one- or two-bus solar cell is used. A model has been devised (and a computer code written to implement it) to calculate the pattern of flux density concentrated on a V-shaped receiver by a parabolic trough and to determine the corresponding I-V curve of the photocell. The authors summarize the model and briefly describe the computer code. 3 refs.

8804 **Low-cost, high-performance, point-focus concentrator array design.** Shafer, B.D.; Edenburn, M.W.; Garner, M.; Togami, H. (Sandia Lab, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 754-759(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Sandia Laboratories has initiated the design and fabrication of optimized photovoltaic concentrator arrays which are meant to demonstrate the technology readiness of actual hardware for the 1980 goal of $2.80/W/sub p/. Two basic approaches are being pursued in parallel. These are a point-focus Fresnel lens concept, and a linear-focus parabolic trough. This study presents the point-focus design. 7 refs.

8805 **Active and passive cooling for concentrating photovoltaic arrays.** Edenburn, M.W. (Sandia Lab, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 771-776(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

This study discusses the optimization, based on minimum energy cost, of active and passive cooling designs for point-focus Fresnel lens photovoltaic arrays and line-focus, parabolic-trough photovoltaic arrays, and compares the two types of cooling. Passive cooling is more cost effective than active for Fresnel lens arrays while the reverse is true for parabolic trough arrays. The analysis produced several other conclusions of interest which are also discussed. 1 ref.

8806 **Empirical study of the interaction of silicon substrate thinness, device design, and solar cell processing.** Pryor, R.A. (Motorola Inc, Phoenix, Ariz). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 815-819(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

The use of wire-saw techniques to slice thin silicon wafers may be one method of reducing silicon substrate costs and enabling cost-effective solar cell fabrication. A discussion is presented of processing experiments performed with thin three-inch diameter wafers sliced directly to 8 mils and 5 mils and then etched to 7 mils and 4 mils, respectively, to guarantee saw damage removal. Wafers wire sawed to 17 mils thickness were processed as reference cells. A baseline process which results in an n+p cell structure and two advanced processes which provide n+pp+ structures were utilized. Solar cell electrical performance was characterized relative to a thick (17 mil) n+p type solar cell. 2 refs.

8807 **Low-cost ion implantation and annealing technology for solar cells.** Kirkpatrick, A.R.; Minnucci, J.A.; Greenwald, A.C. (Spire Corp, Bedford, Mass). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 820-824(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Ion implantation and thermal annealing have been developed for processing junctions and back surface layers in terrestrial solar cells. Silicon cell efficiencies up to 16.5 percent AM1 can now be achieved. Pilot production operations are yielding large-area cells with average efficiencies better than 15 percent AM1. Thermal annealing methods are presently employed but should be replaced by transient process methods in the future. Implantation machines to support 10-MW/yr and 100-MW/yr production lines are being considered. Analyses indicate the cost of junction or back layer implantation can be reduced to /0.01/watt. 8 refs.

8808 **$POCl_3$ gettering of titanium, molybdenum and iron-contaminated silicon solar cells.** Rohatgi, A.; Campbell, R.B.; Davis, J.R.; Hopkins, R.H.; Rai-Choudhury, P.; Mollenkopf, H.; McCormick, J.R. (Westinghouse Electr Corp, Pittsburgh, Pa). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 908-911(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

The effect of Ti, Mo, and Fe on silicon solar cell performance and the response of the contaminated material of $POCl_3$ gettering has been investigated. Mo, Ti and Fe all degrade cell performance, but Mo exhibits the most serious effect. Mo induces a recombination center in silicon at E/sub V/ + 0.30eV; the onset of efficiency degradation occurs at metal concentrations in only the mid 10^{10} cm^{-3} range. $POCl^3$ gettering of Mo-doped ingots prior to cell fabrication, has very little effect on the cell performance. Ti reduces cell performance when the metal concentration exceeds about 10^{11} cm^{-3}; it induces two deep levels in silicon, E/sub V/ +0.30eV and E/sub C/-0.26eV. 12 refs.

8809 **Low cost processes for fabricating silicon solar cells.** Goldman, H.; Wolf, M. (Univ of Pa). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 923-928(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

To facilitate an objective comparison of competing options, a methodology was developed for evaluating the effect of their cell efficiencies, process yields, and module packing factors on the price of energy delivered by the system. For junction formation, the diffusion processes provide a relatively low-cost approach. Their costs per unit cell area can be further reduced by increased wafer area and mechanized wafer handling. Ion implantation could become competitive, if beam currents can be increased by at least an order of magnitude, machine reliability improved, and/or unanalyzed ion implantation proven feasible. The costs for a large variety of projected metallization processes, excluding the costs of the metal, are roughly comparable. 23 refs.

8810 **Effect of production processes on the fracture strength of silicon solar cells.** Chen, C.P.; Royal, E.L.; Klink, H. (Calif Inst of Technol, JPL, Pasadena). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 929-934(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Fracture of Czochralski silicon wafers during processing is an important factor in solar cell yield and cost. A fracture-mechanics tests and analysis program was developed to evaluate fracture strength changes in the in-process wafer-to-cell processing at different stages on a manufacturer's production line. The strength data were described by Weibull statistical analysis and can be interpreted with the surface-flaw distribution of each of the process steps. 9 refs.

8811 Low-cost photovoltaic cell process based on thick film techniques. Mardesich, N.; Bunyan, S.; Pepe, A.; Edwards, B.; Olson, C. (Spectrolab Inc, Sylmar, Calif). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 943-947(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

The low-cost, easily automatable processing being developed for solar cell fabrication is described. These processes include plasma-etching, spray-on diffusion sources and antireflective coating, thick film metallization, aluminum back contacts, laser scribing and ultrasonic soldering. The process sequence has been shown to produce solar cells having 15% conversion efficiency. 2 refs.

8812 Contact integrity testing of stress-tested silicon terrestrial solar cells. Prince, J.L.; Lathrop, J.W.; Witter, G.W. (Clemson Univ, SC). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 952-957(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

The adherence strength of contacting metal is of prime importance to the reliability of solar cells in modules which are naturally subjected to environmentally-induced mechanical stresses. Life-limiting problems can arise if the adherence strength is initially too low, or if it decreases with time in the field. In order to determine the effect of accelerated stress testing (both environmental and time-temperature aging) on the metal-silicon contact integrity (i.e., metallization adherence strength) of silicon terrestrial solar cells, a test procedure was developed and applied to stress-tested cells. Significant effects due to certain stress tests were found for some cell types. 2 refs.

8813 Encapsulation of PV cells using silicone materials. Dennis, W.E. (Dow Corning Corp, USA). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 958-961(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Clear, weather-resistant encapsulants for photovoltaic cells can be a significant cost element in solar arrays. Also, cell output can diminish with time in outdoor service. To address these problems, a search for improved silicone encapsulants was carried out. Five silicone encapsulants were exposed on two types of modules--one using a particular board substrate and the other a glass superstrate. No significant changes in output were noted after 300 days of outdoor exposure and after high humidity and thermal cycling. Because only a thin coating is needed, material costs are 60% lower than with previous encapsulants.

8814 Development of glass encapsulation techniques for terrestrial photovoltaic arrays. Younger, P.R.; Tobin, R.G.; Landis, G.A.; Kreisman, W.S.; Nowlan, M.J. (Spire Corp, Bedford, Mass). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 965-969(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Two parallel development programs for terrestrial solar cell module encapsulation and fabrication are reviewed, including the status of electrostatic bonding as an encapsulation technique. Current designs of electrostatically bonded modules are discussed, fabrication of which is now routine. The design of a high-efficiency module is presented, for which performance reliability features are discussed. This design is compatible with later generation changes such as the introduction of encapsulation by electrostatic bonding. 6 refs.

8815 Flat-plate photovoltaic array design optimization. Ross, R.G. Jr. (Calif Inst of Technol, JPL, Pasadena). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1126-1132(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Specific analyses have been conducted in the areas of structural design optimization, optimization of array series/parallel circuit design, thermal design optimization, optimization of environmental protection features, and others. This work integrates the results from these various studies and draws general conclusions relative to optimal features for future modules. The analysis is based on minimizing the total photovoltaic system life-cycle energy cost including repair and replacement of failed cells and modules. The conclusions presented provide useful design guidelines for designers of future flat-plate photovoltaic modules. 7 refs.

8816 SnO_2/polycrystalline silicon solar cells. Ghosh, A.K.; Feng, T.; Maruska, H.P. (Exxon Res and Eng Co, Linden, NJ). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1169-1172(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

High efficiency solar cells (area greater than 1 cm^2) have been fabricated by spraying $SnCl_2$ onto heated polycrystalline silicon substrates at a temperature lower than 400°C for an interval of a minute or less. For poly-Si with grains approximately 1mm, the efficiency is approximately 10 percent. After a small initial decrease in efficiency, the SnO_2/Si devices become more stable. A theory is developed which allows the calculation of device parameters for polycrystalline silicon solar cells, and experimental results for SnO_2/Si cells are in good agreement.

8817 Grain size dependence of silicon solar cell parameters. Koliwad, K.M.; Daud, T. (Calif Inst of Technol, JPL, Pasadena). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1204-1208(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

An analytical model has been developed for calculation of solar cell output as a function of grain size. Solar cells have been fabricated with varying grain sizes from about 100μm to 1mm. Light and dark I-V characteristics and minority carrier diffusion lengths have been measured. It is shown that the cell output as a function of grain size and diffusion length matches well with that obtained analytically. Variation of open circuit voltage and fill factor with grain size are discussed. Significant result with data of spectral response is also presented. 8 refs.

8818 Development of amorphous silicon stacked cells. Hanak, J.J.; Faughnan, B.; Korsun, V.; Pellicane, J.P. (RCA, Princeton, NJ). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1209-1213(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Several problems have been addressed toward the increase of cell efficiency of multiple-junction (stacked) solar cells of amorphous silicon (a-Si:H). Balancing of thicknesses to maximize Jsc has been done experimentally by the use of thickness-graded cells. Quantum efficiency measurements as a function of cell thickness and bandgap have been made to assist qualitatively in the choice of types of cells in the stack. 8 refs.

8819 Qualification test results for DOE Solar Photovoltaic Flat Panel Procurement, PRDA 38. Griffith, J.S. (Calif Inst of Technol, JPL, Pasadena). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1290-1295(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Twelve types of prototypes modules for the DOE Photovoltaic Flat Panel Procurement (PRDA 38) were subjected to qualification tests at the Jet Propulsion Laboratory according to a new specification. Environmental exposures were carried out separately

and included temperature cycling, humidity, wind simulation, and hail. The most serious problems discovered were reduced insulation resistance to ground and ground continuity of the metal frames, electrical degradation, erratic power readings, and delamination. The electrical and physical characteristics of the newly received modules are also given. 3 refs.

8820 **Influence of module requirements on flat plate module design evolution.** Arnett, J.C.; Ross, R.G. Jr. (Calif Inst of Technol, JPL, Pasadena). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1296-1298(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Photovoltaic module design features and performance characteristics have undergone significant evolutionary changes between pre-1975 First Generation configurations and current Third Generation design technology. A major contributor to this evolution was an iterative process of continuing design guideline and specification development for major module procurements. Module manufacturers have actively responded to these evolving requirements through progressively improving designs. This iterative/feedback process is described. Interim design guidelines and preliminary design options reflecting the LSA 1982 Module Technical Readiness Specification (November 1979) are described with respect to previous design and performance requirements. 2 refs.

8821 **Qualification testing of photovoltaic concentrator modules for system application experiments.** McDowell, J.F.; Pritchard, D.A.; Verardo, A.E. (Sandia Lab, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1299-1305(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

System application experiments currently being funded by the DOE under PRDA-35 have a number of requirements to be met before system construction is begun. One of these requirements is completion of concentrator module performance qualification testing at Sandia Laboratories. This study describes the nature of the qualification tests, the control and data acquisition systems used and typical performance data on representative modules.

8822 **Heterojunction Schottky barrier solar cell.** Yang, H.T.; Miller, D.L.; Shen, Y.D.; Edwall, D.D.; Harris, J.S. Jr. (Rockwell Int, Thousand Oaks, Calif). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1333-1337(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

A systematic study on Au/AlGaAs/GaAs heterojunction Schottky barrier (HSB) solar cells has been done on single crystalline material. The V/sub oc/ of a Schottky barrier (SB) solar cell has been increased up to 75% by use of a heterojunction Schottky barrier structure. Al%, thickness of AlGaAs and doping density of GaAs have been found to be the key factors of a cell's performance. Results of barrier height enhancement due to the heterojunction Schottky barrier structure on large grain polycrystal GaAs are presented, and the potential of this structure for use in low cost polycrystal GaAs solar cells is discussed. 7 refs.

8823 **Epitaxial and polycrystalline GaAs solar cells using OM-CVD techniques.** Yeh, Y.C.M.; Wang, K.L.; Shin, B.K.; Stirn, R.J. (Calif Inst of Technol, JPL, Pasadena). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1338-1342(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

GaAs epitaxial films were grown by chemical vapor deposition using organo-metallic sources (OM-CVD) on single crystal and polycrystalline bulk GaAs, as well as on bulk polycrystalline and recrystallized thin-film Ge substrates. Details of Antireflecting Metal-Oxide-Semiconductor (AMOS) solar cells fabricated on GaAs films grown on bulk polycrystalline Ge and recrystallized Ge thin-film substrates are discussed, as well as preliminary photovoltaic results obtained for n^+/p homojunction structures. 6 refs.

8824 **Semiconductor-insulator-semiconductor (SIS) solar cells: indium-tin-oxide on silicon.** Burk, D.; Shewchun, J.; Spitzer, M.; Singh, R.; Kukulka, J.; Hadrevi, J.; Loferski, J.J. (Brown Univ, Providence, RI). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1376-1383(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Semiconductor-insulator-semiconductor solar cells such as indium-tin oxide on silicon are being extensively investigated because of the unexpected ease with which high efficiencies are achieved using a relatively simple processing technology. However, the experimental results for indium tin oxide, single crystal silicon cells fabricated by ion beam sputtering as well as other approaches have plateaued at 12%. The theory predicts a maximum efficiency of 20%. Authors have undertaken a systematic investigation of the process parameters along with a loss mechanisms study to improve the efficiency above this 12% range. 12 refs.

8825 **Radiation-resistant substrate for a p^+-n-n^+ solar cell.** Jellison, G.E. Jr.; Cleland, J.W.; Fukuoka, N. (Oak Ridge Natl Lab, Tenn). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1398-1399(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

It is found that solar cells fabricated from oxygen-donor doped Czochralski-grown silicon are considerably more resistant to 1.5 MeV electron irradiation than cells fabricated from phosphorus-doped silicon. Correlation with van der Pauw and deep level transient spectroscopy (DLTS) measurements show that 1.5 MeV electron irradiation of oxygen-doped silicon does not result in the creation of a large concentration of deep-lying majority carrier traps, while electron irradiation of group V doped n-type silicon results in the creation of the group V-vacancy, which is a deep-lying majority carrier trap. 9 refs.

8826 **(PNL-SA—7704) Enhanced gasification of wood in the presence of mixed catalysts.** Weber, S.L.; Mudge, L.K.; Sealock, L.J. Jr.; Robertus, R.J.; Mitchell, D.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). [nd]. Contract AC06-76RL01830. 7p. (CONF-790571—7). NTIS, PC A02/MF A01.

From 6. national conference on energy and the environment; Pittsburgh, PA, USA (21 May 1979).

Experimental results obtained in laboratory investigations of steam gasification of wood in the presence of mixed catalysts are presented. These studies are designed to test the technical feasibility of producing specific gaseous products from wood by enhancing its reactivity and product specificity through the use of combined catalysts. The desired products include substitute natural gas, hydrocarbon synthesis gas and ammonia synthesis gas. The gasification reactions are controlled through the use of specific catalyst combinations and operating parameters. A primary alkali carbonate gasification catalyst impregnated into the wood combined with specific commercially available secondary catalysts produced the desired products. A yield of 50 vol % methane was obtained with a randomly mixed combination of a commercial nickel methanation catalyst and silica-alumina cracking catalyst at a weight ratio of 3:1 respectively. Steam gasification of wood in the presence of a commercial Si-Al cracking catalyst produced the desired hydrocarbon synthesis gas. Hydrogen-to-carbon monoxide ratios needed for Fischer-Tropsch synthesis of hydrocarbons were obtained with this catalyst system. A hydrogen-to-nitrogen ratio of 3:1 for ammonia synthesis gas was achieved with steam-air gasification of wood in the presence of catalysts. The most effective secondary catalyst system employed to produce the ammonia synthesis gas included two commercially prepared catalysts formulated to promote the water-gas shift reaction.

1406 Photovoltaic Power Systems

8827 (ATR—79(7694-07)-3) **Photovoltaic mission analysis. Program summary report, 15 August 1978-28 February 1979.** Leonard, S.L.; Kammer, W.A.; Kelley, W.A. (Aerospace Corp., El Segundo, CA (USA). Energy and Resources Div.). Mar 1979. Contract AT03-76ET30351. 25p. NTIS, PC A02/MF A01.

The overall objective of the project since its inception has been to support the planning, development, and guidance of the DOE National Photovoltaic Program on a continuing basis by: (1) identifying and evaluating those photovoltaic applications (including total energy applications) that are most likely to lead to significant contributions to the national energy supply, (2) identifying and evaluating attractive opportunities for demonstration programs and other strategies (e.g. tax incentives) that will stimulate the growth of the near-term (1986-2000) photovoltaic markets, and (3) providing technical support to the DOE Photovoltaic Program Office. The work reported is a direct extension and outgrowth of earlier studies. It includes analytical studies in two areas and a continuation of the program support activities that have been a part of the project since its inception. A summary account is given of the first of these studies, a preliminary examination of the technical and cost impact on utility distribution systems of the introduction of grid-connected residential photovoltaic systems that feed back excess photovoltaic electricity into the utility grid. The second study, is a technical and economic evaluation of a novel photovoltaic power plant concept, a hybrid high-concentration system in which thermal energy removed in cooling the photovoltaic cells is used to generate additional electricity in a bottoming-cycle turbine. (WHK)

8828 (CONF-800995—, pp 207-216) **Status of the Natural Bridges National Monument 100KW photovoltaic power generating system.** McNamara, R.W. (Applied Research and Technology of Utah, Inc., Salt Lake City). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The program objectives and goals, system description, control system, design and startup experience, and operational experience are reviewed. (MHR)

8829 (CONF-800995—, pp 263-271) **Photovoltaic projects at New Mexico Solar Energy Institute.** Zwibel, H.S.; Schaefer, J.F. (New Mexico Solar Energy Inst., Las Cruces). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The New Mexico Solar Energy Institute (NMSEI) is participating in several Department of Energy (DOE) photovoltaic tests and application projects. These projects involve design, construction, operation, and evaluation of a variety of residential and commercial photovoltaic (PV) systems. Two individual projects are intermediate-sized systems presently under construction: a 100-kilowat system at Lovington, New Mexico, and a 20-kilowatt system at El Paso, Texas. A third is a regional photovoltaic residential experiment station intended to foster early implementation of residential photovoltaics. The 20-kW system and the present status of the experiment station are discussed. (MHR)

8830 (CONF-7805216—, pp 59-67) **Estimation of size requirements for solar photovoltaic systems.** Darlington, A.D.; Davies, P.T.; Rosenfeld, J.L.J. (Shell Research Ltd., Chester, England). 1978.

From Conference on storage in solar energy systems; London, UK (5 May 1978).

An isolated system consisting of an array of photovoltaic panels and an electrical storage battery, and feeding in to some kind of an electrical load is considered. Such a system could be considered, for example, for operating a navigational light or an irrigation pump, and its self-contained nature and independence of fuel supplies would make it attractive for inaccessible locations. The determination of the area of array required and the capacity of storage battery required to meet a given load is discussed. A minimum-cost combination of array size and storage capacity is obtained. (WHK)

8831 (CONF-7805216—, pp 68-75) **Battery storage in solar cell systems.** Baikie, P.E. (Chloride Technical Ltd., Manchester, England). 1978.

From Conference on storage in solar energy systems; London, UK (5 May 1978).

Some of the technical and economic problems of combining energy conversion and energy storage in solar cell systems are described based partly upon the results of a computer design program. It is shown that there is no single battery type which is suitable for all applications, but that the choice depends upon a multitude of factors. For example, the need for low-loss batteries is considered to be only a short-term requirement until solar cell prices fall. Finally, some indication is given of what sort of applications are likely to prove attractive when prices fall.

8832 (DOE/ER—0085) **Program assessment report, statement of findings. Satellite power systems concept development and evaluation program.** (National Aeronautics and Space Administration, Washington, DC (USA)). Nov 1980. Contract AI01-79ER10035. 77p. NTIS, PC A05/MF A01.

What is known, uncertain, and unknown about the Solar Power Satellite (SPS) concept is stated. The important technical, environmental, and cost goal questions that must be answered prior to making a commitment to the SPS concept are discussed. Although significant technological, environmental and economic questions remain to be answered, the preliminary investigations undertaken in the CDEP do provide a basis for a policy decision on further commitment. Also, areas of research and experimentation required to acquire the knowledge by which a series of informed, time-phased decisions may be made concerning the possibility of the SPS concept playing a major role in the United States' energy future are suggested.

8833 (DOE/ER—0086) **Satellite Power Systems (SPS) space transportation cost analysis and evaluation.** (Battelle Columbus Labs., OH (USA)). Nov 1980. Contract W-31-109-ENG-38. 140p. NTIS, PC A07/MF A01.

The objective of this study is to provide a clear picture of SPS space transportation costs at the present time with respect to their accuracy as stated, the reasonableness of the methods used, the assumptions made, and the uncertainty associated with the estimates. The approach used consists of examining space transportation costs from several perspectives - to perform a variety of sensitivity analyses or reviews and examine the findings in terms of internal consistency and external comparison with analogous systems. These approaches are summarized as a theoretical and historical review including a review of stated and unstated assumptions used to derive the costs, and a performance or technical review. These reviews cover the overall transportation program as well as the individual vehicles proposed. The review of overall cost assumptions is the principal means used for estimating the cost uncertainty derived. The cost estimates used as the best current estimate are included.

8834 (DOE/ER/10041—T10) **Satellite power system (SPS). Rectenna siting: availability and distribution of nominally eligible sites.** (Rice Univ., Houston, TX (USA)). Nov 1980. Contract AC01-79ER10041. 283p. NTIS, PC A13/MF A01.

Siting of 60 ground receiving stations (rectennas) for the SPS may pose a problem due to the large area per rectenna (15,000 hectares, 38,000 acres) and numerous siting constraints. This study analyzes areas potentially eligible for rectenna sites by mapping, at a national scale, those conditions which would preclude rectenna construction. These exclusion variables which reflect restricted lands, topography, safety, national policy and electromagnetic (microwave) effects, have been computer encoded and tabulated. Subsequent analysis of the nine electric power planning regions that make up the contiguous states indicate an apparently adequate number of nominally eligible sites in all regions in comparison to projected electrical generation. Eligibility in this context means only that areas were not excluded in this national level analysis; more detailed investigation may reveal purely local constraints or smaller scale exclusions. A second major qualification relates to small isolated eligible areas. Eliminating individual eligible clusters with less than nine times the area of one rectenna eliminates much

of the Eastern US; a four-to-one adjacent eligible area test poses no such problem. An independant study of the placement of 60 nominal sites in relation to projected load centers reveals that, even with modest transmission distances, the supply of eligible areas is not a key constraint, except perhaps in the Mid-Atlantic (Electric Reliability) Council Region. Even when several less critical (potential) exclusions are considered, more than 19% of the US is eligible; every region except Mid-Atlantic has at least 50 times an many eligible sites as are required.

8835 **(DOE/JPL/955846—81/1) Report of an exploratory study: safety and liability considerations for photovoltaic modules/panels, Low Cost Solar Array Project.** Weinstein, A.S.; Meeker, D.G. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). Jan 1981. Contract NAS-7-100-955846. 55p. NTIS, PC A04/MF A01.

Product safety and product liability considerations are explored for photovoltaic module/array devices. A general review of photovoltaic literature was made using computerized literature searches. A literature search was also made of relevant legal material as it applies to design. Recommendations are made to minimize or eliminate perceived hazards in manufacture and use of a photovoltaic module/array. (MHR)

8836 **(SAND—80-7062) 10-kilowatt photovoltaic concentrator array fabrication.** Sanders, J.A.; Donovan, R.L.; Broadbent, S. (Martin Marietta Aerospace, Denver, CO (USA)). Dec 1980. Contract AC04-76DP00789. 292p. NTIS, PC A13/MF A01.

The PCA is based on the use of an acrylic Fresnel lens to concentrate sunlight on high intensity solar cells. The array with modified heat sinks was fabricated to determine the impact on electrical performance due to lower weight heat sinks and reduced thermal dissipation surfaces. The array with modified heat sinks was fabricated to determine the impact on electrical performance due to lower weight heat sinks and reduced thermal dissipation surfaces. The array fabrication proceeded with normal problems expected of preproduction prototypes. Three major problems occurred in the areas of the dimensional adequacy of the environmental housing for the Photovoltaic Modules, the cell/substrate assembly and the azimuth drive structural integrity. The cost optimization study identified a new lower weight heat sink design that would reduce the heat sink weight by 50% and the array cost by approximately 3.1% for a loss of only 7% in annularized electrical power generation. The production cost estimate provides an indicator that an overall 87% learning curve can be achieved and the cost of the 5000th unit could be $5.30 per watt in 1979 dollars. System level costs were also developed to project a busbar energy cost for a 10 MW system produced at the 500th unit. This system would provide energy at 24 cents per kilowatt hour average over a 30 year projected life. As a result of wind tunnel tests and the fabrication experience, an array has been designed for production. The key elements of the redesign are discussed. (MHR)

8837 **Low cost structures for photovoltaic arrays.** Post, H.N. (Sandia Lab, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1133-1138(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

The design and analysis of low cost, ground-mounted flat plate nontracking array structures for use in large intermediate and central power station applications are described. Design requirements for the array structure, especially wind loading criteria, are discussed and problem areas associated with the integration of the module panel and support structure are identified. Support system costs which include site preparation, foundation and support structure, and installation costs are summarized. Wind effects data are presented. 6 refs.

8838 **Photovoltaic system sizing analysis.** Jones, G.J.; Mehalick, E.M. (Sandia Lab, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1139-1143(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

A primary concern in designing any photovoltaic system is the determination of its "optimum" size. In grid-connected applications this is normally considered to be one which delivers energy to the owner's load at the minimum lifecycle cost, including the cost of backup utility energy. A great deal can be learned about system design by making use of simple analytical relationships to study the effect of various design parameters on sizing. The purpose of this paper is to show one such model and apply it to study the effect of load and the fixed and variable costs on photovoltaic system sizing. 1 ref.

8839 **25 kW Fresnel lens/photovoltaic concentrator application experiment at Dallas-Fort Worth Airport.** O'Neill, M.J. (E-Syst Inc, Dallas, Tex). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 125-130(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

The U.S. Department of Energy (DOE) has recently selected five different photovoltaic concentrator systems to be built awnd field-tested at various locations around the nation. The only one of these systems which uses a linear refractive concentrator will soon be built and tested by E-Systems at the Dallas-Fort Worth Airport. A description of the system, its performance, its mass-production economics, and prototype collector testing results are presented. 4 refs.

8840 **Protection of terrestrial photovoltaic systems from lightning effects.** Rogers, C.B. (Sandia Lab, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 131-136(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Transients caused by nearby strokes constitute the major threat from lightning to photovoltaic power systems. Failure thresholds of silicon solar cells are dominated by the melting of the metal grid on the illuminated face of the cell. The optical flash from lightning is not a significant threat to cells. The use of guard wires over underground cables appears to be a cost-effective shielding technique. Terminal protection devices are available although their use may require some special design features. 6 refs.

8841 **Application analysis of photovoltaic systems for service/commercial/institutional and industrial sectors.** Whisnant, R.A.; Alberts, R.D. (Res Triangle Inst, Research Triangle Park, NC). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 246-251(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

The service, commercial, institutional and industrial (SCII) sectors of the economy comprise a set of potential photovoltaic (PV) system applications with very diverse energy use characteristics. A set of basic technical and financial attributes have been defined to characterize establishments in these sectors. Photovoltaic systems designed to maximize utilization of insolation have been designed and the cost and benefits in terms of electric energy produced have been determined. A ranking of the members of these sectors disaggregated by two-digit Standard Industrial Classification (SIC) codes has been made. Members of the service, commercial and institutional sectors rank substantially higher than those of the industrial sector as viable PV applications, although some small, light industrial applications would also be suitable. 5 refs.

8842 **Economic feasibility of photovoltaic energy system.** Clorfeine, A.S. (DOE, USA). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 986-989(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

A photovoltaic system is, in principle, economically feasible, when its total life-cycle cost is less than a so-called "break-even" value. In practice however, the prediction of when (or if) economic feasibility will be achieved is uncertain. The system life-cycle cost will be dominated by so-called balance-of-system items including "soft" cost factors (e.g. marketing and distribution) which are often neglected or underestimated. Break-even prices can vary over an order of magnitude depending on specific application factors. An examination is made of the influence on economic feasibility of relevant value and cost factors. 1 ref.

8843 Energy storage in grid-connected applications. Jones, G.J. (Sandia Lab, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1025-1028(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

While energy storage is usually an option when designing any photovoltaic system, in grid-connected applications the decision for or against on-site storage is based on operational considerations. If the photovoltaic system has the option of returning energy to the utility grid for credit, then the question of storage is determined by the capital cost of storage and its efficiency versus the "cost" of sellback in terms of lost energy. An examination is made of this situation, as well as time-of-day pricing, in detail to determine the allowable lifecycle cost of storage in each of the possible operating modes. 6 refs.

8844 Analysis of on-site photovoltaic total energy system options. Federmann, E.F.; Pittman, P.F.; McAllister, W.J.; Feduska, W. (Westinghouse Electr Corp, USA). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1029-1035(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

This study presents a comprehensive and flexible means of optimizing and evaluating on-site, photovoltaic, total-energy systems. Its major advantages are: (1) different systems and alternate energy cost scenarios are easily accommodated, (2) it is accurate and correct, (3) it is adaptable to a wide variety of applications, (4) it can easily be corrected to other methods, and (5) it can be used as a universal standard. This analysis applied to residential solar photovoltaic energy systems shows that if the array cost goals are met and if a government-funded precommercialization program is forthcoming, such systems will begin to become viable in better geographical areas in the 1986-1990 time period. 3 refs.

8845 Simulation of a hybrid solar photovoltaic/solar thermal electric power system. Moite, S.M.; Kallis, J.M.; Castle, J.A.; Aerni, E.; Lessley, R.L. (Hughes Aircr Co, Culver City, Calif). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1036-1041(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

The objective of this project was to develop a tool for use in determining whether a hybrid solar electric power system has advantages, in terms of electrical efficiency and cost of electricity, over a pure solar-photovoltaic system or a pure solar-thermal-electric power system. A hybrid system is defined as an actively cooled photovoltaic system in which the waste heat is used to drive a generator. The cost and efficiency of candidate systems predicted by a steady-state design-point calculation were found to agree closely with those predicted by a more time-consuming hour-by-hour simulation.

8846 Performance evaluation of conceptual hybrid solar photovoltaic/solar thermal electric power systems. Castle, J.A.; Aerni, E.; Moite, S.M.; Kallis, J.M. (Spectrolab Inc, Sylmar, Calif). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1106-1112(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Conceptual designs of solar electrical power plants utilizing both photovoltaic and thermal subsystems have been evaluated. These systems included both distributed and central receiver type concepts using both silicon and gallium arsenide cells. Heat engine cycles covering a wide range of temperatures were evaluated in the overall optimization. An overall system efficiency of 17% was obtained for a hybrid concept utilizing gallium arsenide solar cells in a distributed field using an organic Rankine cycle heat engine. Optimum hybrid systems tend toward low operating temperatures and low thermal-electric conversion. The economic performance is comparable with photovoltaic-only and thermal-only systems. 6 refs.

8847 Photovoltaic intermediate applications. Biringer, K.L. (Sandia Lab, Albuquerque, NM). *Conference Record of the IEEE (Institute of Electrical and Electronics Engineers) Photovoltaic Specialists Conference (U.S.);* No. 80CH1508-1, 1121-1125(1980). (CONF-800106—).

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Intermediate applications for on site photovoltaic systems range in size from about 20 kW to well over 1 MW and cover a variety of users including commercial, industrial, agricultural, multi-family residential, municipal and others. A discussion is presented of results of recent studies in each of these sectors. Characteristics of the load profiles and economic parameters for different users are described along with energy consumption data for the different applications. Preliminary assessments of favorable photovoltaic applications and their economic viability are made and preferred system configurations discussed. 18 refs.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 8726, 8737, 8832, 8844, 8845, 8846, 9025, 9029, 9035, 9060, 9061

8848 (DOE/NASA/1060—4) Applicability of advanced automotive heat engines to solar thermal power. Beremand, D.G.; Evans, D.G.; Alger, D.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1981. Contract AI01-77ET20401. 28p. (NASA-TM—81658; CONF-810206—1). NTIS, PC A03/MF A01.

From Society of Automotive Engineers international engineering congress and exposition; Detroit, MI, USA (23 Feb 1981).

The NASA Lewis Research Center (LeRC) as Project Manager of the Department of Energy's Automotive Heat Energy Program, is developing advanced gas turbine and Stirling engines for automobiles. To accomplish the program goals of improved fuel economy, reduced emissions, and broad alternative fuel capability, major development programs have been undertaken for both engines. These programs are described along with the predicted characteristics of the engines under development and the key technology problems that must be resolved to achieve these objectives. NASA LeRC is also responsible for the development of the power conversion systems for the Parabolic Dish Solar Thermal Power Systems being developed for the Department of Energy by NASA Jet Propulsion Laboratory. The requirements of this solar thermal application are reviewed and compared with the predicted characteristics of the automobile engines under development. A good match was found in terms of power level and efficiency when the automobile engines, designed for maximum powers of 65 to 100 kW (87 to 133 hp) were operated to the nominal 20 to 40 kW electric output requirement of the solar thermal application. At these reduced power levels it appears that the automotive gas turbine and Stirling engines have the potential to deliver the 40+ percent efficiency goal of the solar thermal program. However, in-depth studies are required to determine the extent of modifications required to adapt the engines for the solar application, and to fully assess the probable life, durability and resultant efficiency that can realistically be achieved in this application.

8849 **(SAND—79-8195) CESA-1 receiver design review. Phase 1. Final report.** (Foster Wheeler Development Corp., Livingston, NJ (USA)). Jul 1980. Contract AC04-76DP00789. 82p. NTIS, PC A05/MF A01.

The Central Electrica Solar de Almeria CESA-1 is a 1.0 MWe water/steam solar central receiver electric power plant being built by the Spanish in Almeria, Spain. Centro de Estudios de la Energia (CEE) is responsible for the management, design, and construction of the project. At the request of the Solar Energy Research Institute and with the approval of the Department of Energy, Sandia National Laboratories, Livermore is providing technical assistance in areas unique to solar applications to CEE. At the request of CEE, Sandia contracted with Foster Wheeler Development Corporation (FWDC) to critically review and evaluate the CESA-1 receiver design. Foster Wheeler Iberia (FWI) was subcontracted to FWDC to coordinate efforts with CEE in Madrid. The FWDC program which was started on July 9, 1979, was subdivided into three tasks: (1) design basis review: critical review of the receiver design specifications and requirements; (2) design review and analyses: critical review of thermal/hydraulic, structural, and materials aspects of the receiver design and the design and analysis procedures used by the designer in critical areas of the design; and (3) operational review: critical review of receiver instrumentation and controls and the operational and safety aspects of the receiver. Results of the design review and evaluation are presented. (WHK)

8850 **(SAND—80-2409) Acoustic measurement of boiling instabilities in a solar receiver.** Beattie, A.G. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 56p. NTIS, PC A04/MF A01.

An acoustic technique was developed and used to search for boiling instabilities in the prototype receiver for the Barstow 10 MW Solar Thermal Pilot Plant. Instabilities, consisting of movements of the transition zone between regions of nucleate and film boiling, were observed. The periods of these fluctuations ranged between three and fifteen seconds with no indications of preferred frequencies. The peak to peak amplitudes of the fluctuations averaged 0.4 meters under steady state conditions at absorbed power levels between 2.0 and 3.2 MW. Transient fluctuations with amplitudes up to 2.0 meters were also seen. These transients usually lasted between 30 and 300 seconds. It was not possible to pinpoint the causes of these transients.

8851 **(SAND—80-8047) Fatigue-creep lifetime analysis of four advanced central receiver concepts.** Jones, J.; Napolitano, L. Jr. (Sandia Labs., Livermore, CA (USA)). Jan 1981. Contract AC04-76DP00789. 20p. NTIS, PC A02/MF A01.

Four Advanced Central Receiver (ACR) concepts were analyzed for their fatigue-creep design lifetimes under the guidelines of ASME Boiler and Pressure Vessel Code Case N-47 (1592). Using the flux profiles provided by the designers, the thermal hydraulic performance of an individual tube in a receiver panel was ascertained by computer analysis. A linear model of the tube crown strain for the tube on given supports was then constructed. At the location of highest strain two-dimensional thermal and structural finite element analyses were performed. The computed stresses and strains were used in evaluation of the creep and fatigue design lifetimes by N-47 and compared to the desired lifetime of 30 years. Three of the four designs met or exceeded the desired lifetime and the fourth met the desired lifetime when the factor of safety incorporated in N-47 was reduced. All four designs were judged adequate for the current level of design effort.

8852 **(SAND—80-8245) Cost-performance comparison of water-steam receivers for solar central electric power plants.** Laquil, P.D. III; Schafer, C.T.; Faas, S.E. (Sandia National Labs., Livermore, CA (USA)). Dec 1980. Contract AC04-76DP00789. 39p. NTIS, PC A03/MF A01.

An evaluation of the relative cost performance of large solar central receiver electric power plants utilizing water/steam receivers has been performed. The investigation consisted of a systems integration of receiver conceptual designs from three major boiler manufacturers with advanced turbine conditions and thermal storage designs. The methodology and results of the evaluation are described. The results of the evaluation are described. The results indicate which combinations of receiver designs, storage types and thermodynamic conditions hold promise for significant cost performance improvements when compared to first-generation water/steam technology.

8853 **(SERI/TR—351-461(Vol.1)) Comparative ranking of 0.1 to 10 MW(e) solar thermal electric power systems. Volume I. Summary of results. Final report.** Thornton, J.P.; Brown, K.C.; Finegold, J.G.; Gresham, J.B.; Herlevich, F.A.; Kowalik, J.S.; Kriz, T.A. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1980. Contract AC02-77CH00178. 151p. NTIS, PC A08/MF A01.

This report is part of a two-volume set summarizing the results of a comparative ranking of generic solar thermal concepts designed specifically for electric power generation. The original objective of the study was to project the mid-1990 cost and performance of selected generic solar thermal electric power systems for utility applications and to rank these systems by criteria that reflect their future commercial acceptance. This study considered plants with rated capacities of 1 to 10 MW(e), operating over a range of capacity factors from the no-storage case to 0.7 and above. Later, the study was extended to include systems with capacities from 0.1 to 1 MW(e), a range that is attractive to industrial and other non-utility applications. This volume summarizes the results for the full range of capacities from 0.1 to 10 MW(e). Volume II presents data on performance and cost and ranking methodology.

8854 **Point-Focusing Thermal and Electric Applications Project, a progress report.** Marriott, A.T. (Jet Propulsion Lab., Pasadena, CA). pp 1062-1066 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The Point-Focusing Thermal and Electric Applications (PFTEA) Project (formerly called the Small Power System Application Project) was initiated in late FY 1977. DOE, through an interagency agreement with NASA, selected the Jet Propulsion Laboratory to manage the project. The project's goal is to establish readiness of small solar thermal power systems for a variety of applications having requirements below 10 MWe. Power systems will be developed to the point where subsequent commercialization efforts can lead to successful market penetration. The primary activities within the project are described and recent key results and decisions are presented.

8855 **Small solar plants for electricity supply.** Durand, J.P.; Pirot, L. (SOFRETES, Montargis, France). pp 1067-1071 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

By describing the solar project for DIAKHAO in Senegal, Western Africa, this paper introduces the present stage of technology developed by SOFRETES. Taking in account the environment of remote areas of this part of the world and the technology based on practical applications, a low temperature solar thermal conversion technology is used including flat plate collectors, hot water thermal storage, and Rankine cycle thermal loop. The demand for electricity of a small African community (DIAKHAO) and the solar technology selected to satisfy this demand are described. Components and their integration in the system are described. Factory tests are planned to take place at the end of this year. The DIAKHAO solar plant will be under operation in 1980.

8856 **Economic aspects of solar thermal electric power generation in small utilities.** Bluhm, S.A. (Jet Propulsion Lab., Pasadena, CA); Ferber, R.R.; Mayo, L.G. pp 1072-1076 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A study was performed to examine the economic aspects of solar thermal power plants in synthetic small utilities. Insolation typical of Albuquerque, New Mexico, was used to simulate siting in the southwestern United States. The results indicate that solar ther-

mal plants may be competitive in oil dependent municipal utilities of the Southwest in the 1985 to 2000 time period.

8857 **International Energy Agency small solar power plants project.** Kalt, A.C. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Cologne, Germany). pp 1077-1081 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The IEA SSPS project will be carried out during a relatively short time period. After the plants' design, which is already furnished, the plants will be built within two years, followed by an operational test phase of another two years. Following IEA practice, the execution of the Project will be carried out by an Operating Agent, which in this case is the DFVLR, Cologne, Federal Republic of Germany. There are several objectives and project goals which are presented followed by the resulting technical basic specification, which was the basis for the detailed design, already finished. To give an expression of the assigned technical realization, the main facts of the technical design baseline are given. The two plants will be built on a common site in southern Spain, near Almeria.

8858 **Performance and cost optimization of small solar power stations.** Feustel, J.E. (M.A.N. Munich, Germany). pp 1082-1086 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Small solar power systems of the solar farm type use decentralized absorbers and operate in temperature ranges of about 200°C up to 400°C. To generate these temperatures, collector systems with concentration ratios of 30 up to 50 suns are used in most systems. Due to the principle of decentralized absorption, optimum operating temperatures are about 300°C, and overall efficiencies of solar farm stations are between 8 and 12%. Concerning optimum system sizes there is certainly a considerable economic adventage for solar farms compared to tower systems in the range of 10 to 1000 kW, possibly even up to several MW. A block diagram of a typical solar farm system is shown. Such a system consists of the 4 major subsystems collector field, storage, power conversion and cooling system. System optimization is discussed, and some application examples are given. (WHK)

8859 **30/50 kW/sub E/ solar thermal power plant of the distributed type.** Koehne, R. (DFVLR, Institut fuer Technische Physik, Stuttgart, Germany); Kraft M. pp 1087-1089 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A joint project between M.A.N., Germany and AUXINI, Spain is presented which describes a small solar thermal power plant of the distributed type delivering a maximum electric power output of 30 kW and 50 kW, respectively, if a storage is used additionally to the collector field. The plant build up at Getafe near Madrid, Spain, consists presently of a first collector field with parabolic trough collectors mounted rigidly on a platform which is tracked azimuthally. Collector system efficiencies have been measured and are compared with theoretically predicted values from a transient simulation model. Different temperature spreads and inlet temperatures (between 60 ... 240°C) are investigated and some results of the measured collector system efficiencies regarding also the influence of dust covers on the glass mirrors are given.

8860 **ANSALDO 35 kW solar power system.** Bado, G. (ANSALDO S.p.A., Genova, Italy); Tomei, G.; Angelino, G.; Gaia, M.; Macchi, E. pp 1090-1094 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The conceptual design of a 35 kW solar power system based on the use of linear concentrating collectors is presented. Each collector module consists of two parabolic troughs capable of both elevational and azimuthal alignment. The thermal engine of the system is an organic fluid (perfluorocarbon) multistage turbine prime mover with an efficiency of 25% at 300°C collectors' cooling loop exit temperature. The system is designed for stand alone and for grid-connected operation and, if requested, for the combined generation of power and heat.

8861 **Research and development on solar energy for electric and mechanical power generation.** Almanza, R.; Garibay, J.; Lopez, S.; Munoz, F.; Zarate R. (Universidad Nacional Autonoma de Mexico, Mexico City). pp 1095-1099 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The first thermal mechanical conversion sytem investigated and still under study is a device of 1/2 kW made of focusing collectors which follows the sun furing the day. It consists of 24 m^2 of collectors made of parabolic cylinders covered with aluminized acrylic. In the focal line there is a copper tube with a selective surface of CuO which in turn is situated inside glass tubes which are evacuated to reduce convection losses. The working fluid is steam reaching temperatures higher than 150°C and pressure of 3.5 atm. This system is connected to a piston engine with an efficiency of 20 per cent; the whole system is capable of operating for 4 hours continuously during clear days. Recently a project has been started to generate 35 kW using experience gained from the 1/2 kW system. This new system will consist essentially of about 1000 m^2 of parabolic collectors together with an absorption tube with a film of Cr/ sub x/O/sub y/. The most adequate mechanical system will be studied, i.e., turbine or reciprocating engine. Also there is a rotary engine in the process of development.

8862 **Small solar thermal power plants.** Prast, G. (Philips Research Labs., Eindhoven, Netherlands). pp 1100-1104 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Solar thermal power plants can best be used in small units and could be applied in areas where no power grid exists. Irrigation in rural areas of developing countries is a very urgent need for which solar energy might offer a solution. The design requirements for a solar thermal power plant for this type of use are given. A plant consisting of concentrating collectors, a heat storage unit and a free piston Stirling engine with linear generator is described and some details of the components which are being developed are given.

8863 **Solar thermal-electric power plant with distributed collectors 100 to 1000 kWe.** Mordchelles-Regnier, G.; Dahan, G.; Boy-Marcotte, J.L. (Societe Bertin and Cie, Plaisir, France). pp 1111-1115 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Optimization of the solar power system, comprising a field of collectors, storage unit and thermal engine, is of capital importance in reducing kWhe costs. The optimization depends on the peak power and daily energy required by the user; in the 100 to 1000 kWe power range, the optimum heat-source temperature is between 200° and 250°C. Testing of components under such optimum conditions shows that line-focus collectors convert 40 to 50 percent of the direct solar flux into thermal energy and that a turbine using heavy organic fluid converts over 20 percent of this thermal energy into mechanical energy. The net ratio between electric power delivered and solar power received is near 10 percent with a solar flux of 800 W/m^2. Finally, two spinoffs of this project appear promising. First, the collectors and the storage system form a medium-temperature (100° to 250°C) heat generator which should find applications in the production of industrial heat. Second, the thermal engine, comprising the heat exchangers and the turbogenerator, can be employed not only with solar heat but also with heat recovered in factories having excess heat above 150°C.

8864 Definitive design of the solar total energy large scale experiment at Shenandoah, Georgia. Hunke, R.W. (Sandia Labs., Albuquerque, NM); Mertz, W.S.; Poche, A.J. Contract EG-77-C-04-3985. pp 1116-1120 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The US Department of Energy, with Sandia Laboratories providing technical support and management, is now completing Phase IV Definitive Design of a six-phase Project for conducting a Solar Total Energy Large Scale Experiment at Shenandoah, Georgia. General Electric Company is designing the Solar Total Electric System (STES) with capacity to supply 60% of the total electric and thermal requirements of the 42,000 square foot Bleyle of America knitwear plant to be served at the Shenandoah Site. The system will provide 400 kilowatts electrical and 3.5 megawatts thermal energy. The STES has a classical, cascaded total energy system configuration. It utilizes parabolic dish collectors, trickle oil thermal energy storage and a steam turbine-generator. The electrical load peak shaving system is being designed for interconnected operation with the Georgia Power system.

8865 Solar thermal electric power in the range of medium size units: the French programme THEK. Peri, G. (Univ. de Provence, Marseille, France); Desautel, J.; Imbert, B.; Audibert, M.; Pasquetti, R.; Battistelli, J.P.; Deflandre, J.; Traisnel, J.P. pp 1121-1124 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The status of the French project to design and construct medium range (50 to 500 kWe) solar thermal power plants is outlined. The prototype unit designed employs segmented parabolic dish collectors. (WHK)

8866 Solar thermal-electric experimental plant. Rubeck, M.; Beverly, W.D. (Boeing Engineering and Construction Co., Seattle, WA). pp 1125-1129 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

One approach to generating electricity from solar energy is to utilize an open Brayton-cycle in a central receiver type solar thermal-electric power plant. An important next step in the development of this technology is the design, construction, and operation of an experimental plant. Boeing Engineering and construction Co., under contract to the Electric Power Research Institute, conducted a nine-month study to develop a conceptual design and definition of an open Brayton-cycle experimental plant of about 1.5 MW electric output. The assumptions, analyses, and results of the conceptual design effort are described.

8867 Self supporting solar power system for an isolated community. Bignon, M.J. (CETHEL, Paris, France). pp 1130-1133 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

There are many remote and sunny places in the world where electric power cannot be supplied by a distribution network. Solar energy is well suited for middle sized local generation but it must be supplemented to achieve the required reliability. A self-supporting combined solar-thermal power production system developed with the help of a grant from the French national scientific and technical development fund is described.

8868 Solar ten megawatt pilot plant. Hallet, R.W. Jr.; Gervais, R.L. (McDonnell Douglas Astronautics Co., Huntington Beach, CA). pp 1137-1140 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The requirements and characteristics of the Solar Central Receiver Ten Megawatt Pilot Plant presently under design/construction by the United States Department of Energy in Barstow, California is described. The system requirements, characteristics, operating modes, and site features are presented. The system can be characterized as a surrounded field configuration with radial stagger heliostat layout, capable of generating 10 MWe net directly from insolation and 7 MWe net from thermal storage. Water/steam is the primary working fluid where a single-pass-to-superheat external receiver (steam generator), located atop a 91-meter tower, is used to convert solar radiation to thermal energy. Thermal storage is provided by a dual-media, rock and oil thermocline type, sensible-heat-storage system. Control of the plant is primarily automatic with capability of operator override. The plant has capabilities for both sun and load following operation, possessing eight steady-state operating modes.

8869 Thermal fatigue analysis of the Department of Energy Barstow Pilot Plant. Jones, J.F. (Sandia Labs., Livermore, CA). Contract AC04-76DP00789. pp 1141-1145 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Two types of thermal fatigue which might occur in the Department of Energy Barstow Pilot Plant are discussed: fatigue due to oscillations of the point of departure from nucleate boiling (DNB) in the once-through boiler and fatigue due to the daily cycling of the plant. The results of the two fatigue calculations indicate that the Barstow Pilot Plant should not have a serious fatigue problem from either DNB oscillations or daily cycling, although the design life does not greatly exceed the desired 30 years. In addition, the possible mitigating effects of tube bending are considered, but it is found that little improvement in fatigue life can be expected from this source.

8870 Sodium cooled solar central receiver power station. Johnson, T.L.; Glasgow, L.E.; Thomson, W,B.; Frangos, A.Z. (Rockwell International, Canoga Park, CA). Contract AC03-78ET21050. pp 1146-1150 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A study of a sodium system central receiver-type solar thermal power plant in the size range from 100 to 300 MWe has been completed for the Department of Energy. The sodium system central receiver plant is similar in concept to the water/steam system to be built in Barstow. However, liquid sodium is heated in the receiver at the top of the tower in place of water, and steam is generated at ground level using sodium-to-water heat exchangers. Sodium has many advantages as a heat transfer fluid due to its conductivity. The economic analysis shows that these plants with storage duration of about 13-hr capability have a busbar energy cost comparable to or less than that for new fossil-fueled electric generating plants. Storage durations of 13 hr permit around-the-clock operation for about one-half year.

8871 Assessment of solar hybrid repowering for electric utilities. Groves, D.J. Jr. (Public Service Co. of New Mexico, Albuquerque); Maddox, J.D.; Lang, W.R.; Parker, W.G. pp 1156-1160 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Public Service Company of New Mexico (PNM) has completed an assessment of the solar hybrid repowering concept for electric utility application. The concept consists of locating solar hardware adjacent and connected to existing gas- and oil-fueled electric generation units to displace a portion or all of the fossil fuel normally used during daylight hours. The commercial market potential for the concept was established by performing a survey of utilities comprising most of the electric power generating capacity in the southwestern United States. A cost/benefit analysis, performed for four selected Southwestern utility systems, indicates that the solar hybrid repowering concept has the potential to be economically attractive for utility applications when compared with

conventional methods of electric power generation. A conceptual design was prepared utilizing PNM's Reeves Unit No. 2 for a 50 percent solar repowering (25 MWe produced by solar for 50 MWe total output) based on the central receiver concept being designed for the 10 MWe Pilot Plant at Daggett, California. A fourth level work breakdown structure and detailed schedule have also been developed for a demonstration of the concept.

8872 Economic implications of a low cost heliostat design. Easton, C.R.; Blackmon, J.B. (McDonnell Douglas Astronautics Co., Huntington Beach, CA). pp 1161-1165 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Design and costs of a prototype heliostat for the Central Receiver Solar Thermal Power System are presented and comparisons made with commonly manufactured items. Central receiver thermal energy costs are shown to be competitive with fossil fuels.

8873 Distributed line focus solar central power plant performance and cost summary in comparison to first generation point focus power plant technology. Semmens, M.G.; Collaros, G.J.; Fong, A. (BDM Corp., Albuquerque, NM). pp 1166 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

8874 Utility problems of central tower solar plant in Italy. Borgese, D.; Cefaratti, G. (ENEL - Thermal and Nuclear Research Centre, Milano, Italy). pp 1167-1171 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Solar energy could be regarded as one of the possible integration sources in countries such as Italy, where energy has to be mostly imported. So the Italian National Electricity Generating Board (ENEL) has promoted an important research programme in the solar field. Futhermore, ENEL is part of a consortium charged with the construction of the EEC's Eurelios, the 1 MW(el) Solar Power Plant, at Adrano (Sicily). ANSALDO (Italy), CETHEL (France) and MBB (FRG) are the other partners among the Consortium. The future exploitation of this experimental plant will be of great value not only to clarify many design probelms but also to place confidence in the operation of such type of plants. Owing to the characteristics of variability and intermittance and if a continuous production has to be warranted, solar energy requires a careful consideration as far as its utilization is concerned. Where important hydro-electric plants exist, the possibility of integrations between solar and hydro-electric energy must be considered due to some similarity of the two sources. The expectancy of solar plants should be confirmed in terms of maneuverability and reliability of performance.

8875 Economic analysis of the STEPS in Japan. Tani, T.; Sawata, S.; Tanaka, T.; Kaminoto, M.; Sakuta, K.; Ezawa, N.; Horigome, T. (Electrotechnical Laboratory MITI, Tokyo, Japan). pp 1172-1176 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The simulation program was developed for the estimation of optimum electrical energy cost of STEPS (Solar Thermal Electric Power System) in Japan using hourly normal solar flux data, various collector area, storage capacities, turbine inlet temperatures and cost model. In Japan, the minimum electrical energy costs of the distributed system and the tower heliostat system were estimated from viewpoints of the collector area, storage capacities and electric capacities.

8876 1 MWe European Solar Tower Plant. Strub, A. (Commission of the European Communities, Brussels Belgium); Toth, G. pp 1181-1184 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The project of the Commission of the European Communities to design and construct a 1 MWe tower focus power plant is described. The heliostat field, the receiver, the storage system, and the steam cycle are described. (WHK)

8877 Optimization of the combined structural components of large-power solar central receiver systems. Dunder, V. (Sandia Lab., Livermore, CA). pp 1224-1228 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The cost of large-power solar systems must be significantly decreased if solar power is to be competitive with other power sources. The optimization of the structural subsystem of the central solar receiver concept for power generation is studied.

8878 Optimization procedure for solar thermal electric power plant design. Bohon, W.M.; Levy, S.L. (Black and Veatch, Kansas City, MO). pp 1229-1232 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The design of a solar thermal electric power plant to produce electricity at the least cost involves a great number of performance/cost evaluations. A sound engineering approach to this optimization task is through suboptimization, e.g., maximize the performance (energy output) of each plant design considered and then select the best design via differential cost estimates (minimize cost of electricity). A procedure is presented for designing a solar thermal electric power plant such that plant performance is maximized.

8879 DELSOL: a code for central receiver performance and optimization calculations. Dellin, T.A.; Fish, M.J. (Sandia Labs., Livermore, CA). Contract AC04-76DP00789. pp 1233-1237 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

DELSOL is a quick and accurate computer program for calculating the field performance, field layout and optimal system design for solar central receiver plants. The code consists of a detailed model of the optical performance, a simpler model of the nonoptical performance, and algorithms for field layout and finding the best system design. The latter two features are coupled to a cost model of central receiver components and an economic model for calculating energy costs. The code can handle flat, focused and/or canted heliostats and external cylindrical, multi-aperture cavity, and flat plate receivers. The program optimizes the tower height, receiver size, and field layout as a function of power level.

8880 Cost/performance of large central receiver power systems as a function of heliostat design parameters. Fish, M.J.; Dellin, T.A. (Sandia Labs., Livermore, CA). Contract AC04-76DP00789. pp 1238-1242 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The heliostat field comprises the largest expense as a subsystem of a solar central receiver power plant. Potential cost reductions might be achieved by either total redesigns or subcomponent substitution in existing designs. The value of changing any of several design specifications in the current baseline glass/metal heliostat is discussed. Results are quantified in terms of the breakeven cost; i.e., the cost of a new design which will yield the same total system energy cost as the baseline system. Changes in pointing accuracy,

surface quality, mirror reflectivity, canting and focusing strategy, and heliostat size are evaluated.

8881 **Investigation of optimum heliostat spacings for the sub-tower region of a solar power plant.** Walzel, M.D. (Univ. of Houston, TX). Contract EG-77-C-04-3974. pp 1243-1247 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The RCELL system of computer programs developed at the University of Houston can give information concerning the optimal placement of heliostats for a Solar Tower. This information is taken from a cellular structure of the heliostat field which has a representative at the center of each cell. The inner cells adjacent to the tower can have problems finding an optimum solution for heliostat spacing. Mechanical limits become a problem when solutions require heliostats to be placed closer than allowed. Hexagonal close-packed arrays are investigated in this region oriented along a North-South direction and along an East-West direction. Annual performance, shading and blocking losses are investigated and compared in this important region of the heliostat field which has nominally twice the heliostat density of the field average. The resulting information can aid designers in coping with problems of heliostat neighborhood configuration and coordinate generation near the tower.

8882 **Theoretical consideration on solar concentrations by central receiver systems.** Sakurai, T. (Tohoku Univ., Japan). pp 1248-1252 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Solar concentrations by central receiver systems have been calculated theoretically assuming that plane heliostat-mirrors, sufficiently small in dimension, cover a circular field without clearance. For the solar radiation incident normal to the heliostat-field, the volume- as well as area-concentration were found to be maximum when the radius of heliostat-field was nearly the same as the height of receiver. The optimum radius showed a slight increase with increasing obliquity of incident radiation. The decrease of concentration with increasing mirror-dimension was estimated by a convenient method. The effect of the geometry of composite mirror on the concentration was discussed also.

8883 **Study on mirror fields for tower type solar power plants.** Francia, G. (Univ. of Genoa, Italy). pp 1271-1275 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

It is well known that the image of parallel beams inclined by PSI with respect to the spherical mirror axis are reflected in a complex figure, called caustic. To obtain a punctiform image in the receiver of parallel raking beams with respect to the normal in the center S of the mirror, the latter must be a portion of a paraboloid having focus in C, axis directed towards the sun and passing through S. Since this paraboloid will change with the sun, such a mirror is impossible. In this paper, the author suggests to replace the various paraboloid sectors by double curvature mirrors, capable of rotating about their normal n, so that the minimum mirror curvature will remain on the sun-mirror-receiver plane. The results thus obtained are compared with those of a spherical mirror.

8884 **Thermodynamic trade-offs for gas cooled high temperature solar tower receivers.** Heidt, F.D.; Schwarzott, W. (Dornier System GmBH, Friedrichshafen, Germany). pp 1346-1349 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

As in several countries today a first generation of central solar tower plants is under construction or even in operation, scientific and engineering efforts are now increasingly focused on high power and high temperature developments. To the same extent as plant operation temperatures are raised receiver configurations become more crucial due to heat transfer and material constraints. Usually detailed thermal node models executed by means of computer programs are required. Some basic problems, however, can be suitably treated by analytical approaches.

8885 **Catalyzed thermal conversion of SO_3 to $SO_2 + O_2$ for solar thermal power.** Baranyi, A.D. (Ontario Research Foundation, Mississauga); Stournaras, C.J.; Murthy, M.K.; Chubb, T.A. pp 1359-1361 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

As part of the Solchem concept of chemical transfer of solar energy from collectors to a central receiver, a new cordierite ceramic converter-heat exchanger has been developed for the thermal conversion of SO_3 to $SO_2 + SO_2$. The ceramic converter-heat exchanger has good mechanical strength at high temperatures, low thermal expansion, low porosity and good resistance to attack by SO_3 and SO_2. Conversion of SO_3 to $SO_2 + O_2$ has been demonstrated in straight pieces of the ceramic converter-heat exchanger with platinum catalyst at temperatures from 800 to 1000°C. Conversion of SO_3 at 1000°C approaches 95% (maximum theoretical efficiency).

8886 **Study and realization of a high temperature air cooled solar receiver.** D'Utruy, B.; Blay, D.; Ortiz, F. (Laboratoire d'Energetique Solaire, Poitiers, France). pp 1367-1370 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

An elementary solar panel is developed to warm up air to 800°C for use with a Brayton cycle air turbine. A honeycomb cell profile is retained to absorb the radiant energy in small cavities and to warm up the air by forced convection. A theoretical approach is made to evaluate the metal temperature of the panel (40 x 60 cm) under steady state conditions. Theoretical values are compared to experimental data obtained on a test set up with 72 kW quartz lamps.

8887 **Testing procedures and test results for the EPRI/ Boeing gas-cooled receiver tested in the Central Receiver Solar Thermal Test Facility.** Gintz, J. (Boeing Engineering and Construction, Seattle, WA); Zentner, R.; Marshall, B.; Matthews, L. pp 1377-1381 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

An initial series of central receiver solar thermal tests was completed at the US DOE Central Receiver Test Facility in February 1979. These first production tests in the new facility consisted of experiments with a one megawatt Gas Cooled Receiver for Brayton Power Cycle applications. The receiver was designed and fabricated by Boeing Engineering and Construction under contract to EPRI. The testing was jointly sponsored by EPRI and DOE. The Gas Cooled High Temperature Receiver, the planning required for accomplishment of a major solar/thermal test, and preliminary test results including solar power measurements and experimental results are described.

8888 **Testing of the 10-MWe pilot plant solar central receiver.** Coleman, G.C. (McDonnell Douglas Astronautics Co., Huntington Beach, CA); Friefeld, J.F. pp 1382-1386 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Insolation testing is being conducted at the Central Receiver Test Facility (CRTF) at Albuquerque, New Mexico, to confirm the solar receiver design for the Department of Energy's first solar thermal electric pilot plant at Barstow, California. The test assembly, which consists of a receiver panel and supporting control and instrumentation hardware, essentially duplicates, both physically and functionally, one full-scale module of the external, single-pass-to-superheat solar receiver. Testing includes receiver operation under all insolation and operating conditions anticipated for the pilot plant. Receiver steady-state and transient operating characteristics and performance are being investigated during normal pilot

plant startup, mode transitions, and shutdown sequences, during intermittent cloud conditions, and during simulated emergency situations. Testing will conclude with limit testing of the receiver to flux and power levels 25% above the maximum expected pilot plant conditions, using solar reflector/concentrators.

8889 **Operation of the Central Receiver Test Facility.** Marshall, B.W.; Holmes, J.T. (Sandia Labs., Albuquerque, NM). pp 1400 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

8890 **Solar-powered irrigation system for Bakel, Senegal.** Keiser, J. (Thermo Electron Corp., Waltham, MA); Dustin, P.; Durand, J.P. Pirot, L. pp 1492-1495 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A solar-thermal water pumping system is being constructed to provide 6400 m^3 of irrigation water per day for the remote village of Bakel, Senegal. Located in the Sahel region of Africa, the Bakel area has been plagued by droughts over the past 40 years. An abundance of sunshine and the proximity of the site to the Senegal River make the solar-powered irrigation system a promising solution to the dual problems of drought and the rising costs of imported fuels. The nominal mechanical energy output from the plant is 32.4 kW and is provided by a Rankine-cycle turbine. Because water is used in the collector loop and Freon II is used as the working fluid for the turbine, the system operates at the relatively low temperatures and pressures associated with water at 95°C, which is the outlet temperature of the collectors. During much of the day, between mid-morning and mid-afternoon, the solar insolation will be greater that that needed to provide heat to the Freon boiler. The excess energy that is collected during this time will be stored in a 320-m^3 water storage tank and returned to the system when the collectors are unable to maintain the required heat input. The nominal pumping capacity of the plant is 6400 m^3/day (1,700,000 gal).

8891 **Free cylinder Stirling engine solar powered water pump.** Beale, W.R. (Sunpower Inc., Athens, OH). pp 1496-1500 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A free cylinder Stirling engine expressly designed for use as a solar water pump is described. The pumping action takes place as a result of the reciprocating motion of the cylinder of the sealed free piston engine, this cylinder motion being used to directly drive a reciprocating water pump. A 240 watt unit is described, comprised of a free cylinder engine, a faceted focusing collector containing many small mirrors, an equitorial mount, clock drive, tracker and tensioned cable pump. Expected cost of a complete system delivering 250 watts to the water (25 liter-meters/sec) is about $500 in large scale production.

8892 **Operational experience of a 3.0 kW solar powered water pump.** Maccio, C. (Ansaldo S.p.A., Genova, Italy); Tomei, G.; Angelino, G.; Gaia, M.; Macchi, E. pp 1501-1505 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

During the Spring of 1978 a solar powered pumping system has been put in operation on the roof of an office building at Ansaldo, for demonstration and experimental purposes. The plant design and operation are described, and the obtained results on the performance of the organic Rankine cycle engine, having a single stage turbine as the expander, are presented.

8893 **Solar plants for water pumping and/or electricity supply in intertropical zones.** Durand, J.P.; Mercier, D. (SOFRETES, Montargis, France). pp 1506 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

8894 **Rotary expander for a solar thermo-mechanical conversion system.** Chicurel, R. (Universidad Nacional Autonoma de Mexico, Mexico City). pp 1507-1510 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The third and latest version of a rotary steam engine under development at the Engineering Institute of the National Autonomous University of Mexico is described. The working chamber is bounded by four oval-shaped rotors and two side cover plates. The rotors rotate at the same constant speed and in the same direction. Two impulses occur per revolution. The engine's displacement is 208 cm^3 and the expansion ratio is 4.15. It will form part of a solar powered Rankine system operating with water as working fluid. The design output is 2 kW of mechanical power. If tests prove satisfactory, a larger engine will be built for a scaled-up system producing 35 kW.

1408 Ocean Thermal Gradient And Salinity Gradient Power Systems

8895 **(ANL/OTEC-BCM—014) In situ heat exchanger tube fouling thickness measurements using ultrasonics. Final report on a laboratory feasibility study.** Hirshman, J.; Munier, R.S.C. (Army Nuclear Agency, Fort Bliss, TX (USA); Tracor Marine, Port Everglades, FL (USA)). Sep 1980. Contract W-31-109-ENG-38. 38p. NTIS, PC A03/MF A01.

The growth of fouling layers on heat exchanger surfaces and the corrosion of heat exchanger materials exposed to seawater have been recognized since the beginning of OTEC research as basic problems which could render the concept uneconomical. Consequently, a significant effort has been directed toward predicting, measuring, identifying, explaining and solving potential biofouling and corrosion phenomena. To address this problem, the feasibility of establishing a practical microacoustic technique to measure fouling film thickness in situ on typical OTEC heat exchanger tasks was studied. Seven techniques were studied for this application, including velocity measurements, acoustic diffraction, acoustic interferometer, Doppler flow velocity, pulse echo, critical angle, and surface (shear) wave effects. Of these, the latter five were laboratory tested using conventional microacoustic system components in various configuratons. Only the pulse echo technique yielded promising results. On fouled aluminum plates, thin film layers of 40 μm and greater were measured using a focused 30 MHz ceramic transducer operated at 25 MHz; this represents a resolution of about 2/3 wavelength. Measurements made on the inside of fouled 1" aluminum pipes yielded film thicknesses of 75 to 125 μm. The thinnest layer resolved was approximately 1-1/4 wavelength. The resolution of slime layer thicknesses in the magnitudes of OTEC interest (5 to 30 μm) using pulse echo microacoustics will require transducer development. In particular, a higher operating frequency (150 to 200 MHz) and advanced material construction is recommended for further research.

8896 **(DOE/EA—0121) Seacoast Test Facility, Stage I: environmental assessment.** (Argonne National Lab., IL (USA)). Nov 1980. Contract W-31-109-ENG-38. 77p. NTIS, PC A05/MF A01.

The proposed action is the construction and operation of Stage 1 of the Seacoast Test Facility (STF-1). The facility, to be located at Ke-ahole Point on the west coast of the Island of Hawaii, will withdraw a nominal 1890 L/s (500 gpm) of surface seawater from the ocean adjacent to the site for use in biofouling and corrosion control experiments critical to Ocean Thermal Energy Conversion (OTEC) development. The used water will be discharged to the land, and will flow toward and eventually enter the Class AA ocean waters adjacent to the site. No biocides of any kind will be used during the initial experiments at STF-1, and no NPDES permit will be required for discharges during these experiments. Following the initial experiments, chlorine will be used at STF-1, and a NPDES permit (or exemption) will be sought (using

existing procedures for discharges from research activities) for the discharge of small amounts of chlorinated water from STF-1. This environmental assessment is concerned primarily with the proposed operation of Stage 1 of the Seacoast Test Facility. Brief discussion of Stage 2 of the Seacoast Test Facility (STF-2) is included, although environmental review of STF-2 will be distinct from that of STF-1, and covered in a separate document.

8897 **(DOE/SF/20235—T1(Vol.1)) Current-wave spectra coupling project. Volume I. Hurricane fields and cross sections, surface winds and currents, significant waves and wave spectra for potential OTEC sites: [A] Keahole Point, Hawaii, 100 year hurricane; [B] Punta Tuna, Puerto Rico, 100 year hurricane; [C] New Orleans, Louisiana, 100 year hurricane; [D] West Coast of Florida, 100 year hurricane; and for [E] Hurricane Camille (1969) off Louisiana Coast.** Bretschneider, C.L. (Hawaii Univ., Honolulu (USA). James K.K. Look Lab. of Oceanographic Engineering). Jun 1980. Contract AT03-76SF20235. 142p. NTIS, PC A07/MF A01.

This volume is an extension of and consists of several modifications to the earlier report by Bretschneider (April 1979) on the subject of hurricane design wind, wave and current criteria for the four potential OTEC sites. The 100-year hurricane criteria for the design of OTEC plants is included. The criteria, in addition to the maximum conditions of winds, waves and surface current, include: hurricane fields for wind speed U/sub s/ and significant wave height H/sub s/; hurricane fields for modal wave period f_0^{-1} and maximum energy density S/sub max/ of the wave spectrum; the corresponding Ekman wind-driven surface current V/sub s/; tabulated cross-sections for U/sub s/, H/sub s/, f_0^{-1} and S/sub max/ through max U/sub s/ and through max H/sub s/ along traverses at right angles to and along traverses parallel to the forward movement of the hurricane; most probable maximum wave height and the expected corresponding wave period, based on statistical analysis of maximum wave heights from five hurricanes; design wave spectra for maximum U/sub s/ and also maximum H/sub s/, since maximum U/sub s/ and maximum H/sub s/ do not occur simultaneously; the envelope of wave spectra through maximum U/sub s/ and through maximum H/sub s/ along traverses parallel to the forward movement of the hurricane; the above same determinations for Hurricane Camille (1969) as for the four OTEC locations; and alternative methods (suggested) for obtaining design wave spectra from the joint probability distribution functions for wave height and period given by Longuet-Higgins (1975) and C.N.E.X.O. after Arhan, et al (1976).

8898 **(DOE/SF/20235—T1(Vol.2)) Current-wave spectra coupling project. Volume II. Hurricane fields and cross sections, surface winds and currents, significant waves and wave spectra for potential OTEC sites: [A] Keahole Point, Hawaii, 100 year hurricane; [B] Punta Tuna, Puerto Rico, 100 year hurricane; [C] New Orleans, Louisiana, 100 year hurricane; [D] West Coast of Florida, 100 year hurricane; and for [E] Hurricane Camille (1969) off Louisiana Coast. Technical support for Volume I.** Bretschneider, C.L.; Huang, T.S.; Endo, H. (Hawaii Univ., Honolulu (USA). James K.K. Look Lab. of Oceanographic Engineering). Jul 1980. Contract AT03-76SF20235. 132p. NTIS, PC A07/MF A01.

This volume represents the details of the technical development of and the calibration of the two-directional three parameter wave forecasting relationships, which are specially adapted for forecasting hurricane significant wave height, H/sub s/, modal wave period f_0^{-1} and the peak of the wave spectrum, S/sub max/. These three parameters lead to the determination of the three-parameter wave spectrum which has been verified by use of hurricane wind generated wave spectra from Hurricane Eloise (1975). The hurricane wind field is still based on the original US Weather Service model as given by Meyers (1954). Hurricane winds, waves and wave spectra data from Hurricane Eloise (1975) published by Withee and Johnson, NOAA (1975), have been used. Although the data is of an analyzed form, the term raw data was used as distinguished from smoothed data. An analysis of the raw data is presented in this volume, and considerable sense of the analysis has been made. A weighted average technique was not used, but could have reduced the scatter in the so-called raw data during the first 2/3 of the storm when the winds and waves were less than gale force and quite variable. There is considerably less variability in the wind and wave data when the wind reaches gale force, and these are the data for which the greatest emphasis is given in the analysis. (WHK)

8899 **(DOE/SF/20235—T1(Vol.3)) Current-wave spectra coupling project. Volume III. Cumulative distribution of forces on structures subjected to the combined action of currents and random waves for potential OTEC sites: [A] Keahole Point, Hawaii, 100 year hurricane; [B] Punta Tuna, Puerto Rico, 100 year hurricane; [C] New Orleans, Louisiana, 100 year hurricane; [D] West Coast of Florida, 100 year hurricane.** Venezian, G.; Bretschneider, C.L. (Hawaii Univ., Honolulu (USA). James K.K. Look Lab. of Oceanographic Engineering). Aug 1980. Contract AT03-76SF20235. 255p. NTIS, PC A12/MF A01.

This volume details a new methodology to analyze statistically the forces experienced by a structure at sea. Conventionally a wave climate is defined using a spectral function. The wave climate is described using a joint distribution of wave heights and periods (wave lengths), characterizing actual sea conditions through some measured or estimated parameters like the significant wave height, maximum spectral density, etc. Random wave heights and periods satisfying the joint distribution are then generated. Wave kinetics are obtained using linear or non-linear theory. In the case of currents a linear wave-current interaction theory of Venezian (1979) is used. The peak force experienced by the structure for each individual wave is identified. Finally, the probability of exceedance of any given peak force on the structure may be obtained. A three-parameter Longuet-Higgins type joint distribution of wave heights and periods is discussed in detail. This joint distribution was used to model sea conditions at four potential OTEC locations. A uniform cylindrical pipe of 3 m diameter, extending to a depth of 550 m was used as a sample structure. Wave-current interactions were included and forces computed using Morison's equation. The drag and virtual mass coefficients were interpolated from published data. A Fortran program CUFOR was written to execute the above procedure. Tabulated and graphic results of peak forces experienced by the structure, for each location, are presented. A listing of CUFOR is included. Considerable flexibility of structural definition has been incorporated. The program can easily be modified in the case of an alternative joint distribution or for inclusion of effects like non-linearity of waves, transverse forces and diffraction.

8900 **(DOE/SF/20235—T1(Vol.4)) Current-wave spectra coupling project. Volume IV. Part A. Formulation of the three-dimensional structure of storm-generated currents. Part B. Summaries of Volumes I, II and III.** Venezian, G.; Bretschneider, C.L. (Hawaii Univ., Honolulu (USA). James K.K. Look Lab. of Oceanographic Engineering). Sep 1980. Contract AT03-76SF20235. 191p. NTIS, PC A09/MF A01.

An attempt is made to formulate the technical approach to the problem of three dimensional wind driven currents under hurricane conditions. Reference is given to the splendid piece of research on the subject by Forristall (1974) Three-dimensional structure of storm-generated currents, J. Geophys. Res. 79, 2721-2727. The present approach, although not entirely satisfactory, seems to be an improvement on the work by Forristall, but this remains to be verified with future work, including the use of measured data. An improvement could be made if there were some better way of representing the shear stress as a function of the wind velocity (wind speed and direction). It seems that the wind velocity relative to the water motion is what matters, but in turbulent flow the surface value is not well defined. This difficulty leaves one with an unbalanced vortex stretching which accounts for the spin-up of the fluid, but the details of that are lacking. Essentially, it appears that it is feasible to modify Forristall's approach to obtain a more realistic representation of the structure of the boundary layer to take into account the turbulent nature of the flow.

8901 **(LBL—11926) Commercial fishery data from a proposed ocean thermal energy conversion (OTEC) site in Puerto Rico.** Ryan, C.J.; Jones, A.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1980. Contract W-7405-ENG-48. 53p. NTIS, PC A04/MF A01.

This report describes the fish resources at a proposed OTEC site based upon commercial fisheries data from Puerto Rico. Records of commercial landings and relative fishing effort are used to

examine temporal fluctuations in the abundance of exploited fish stocks at a proposed OTEC site located off the southeast coast of Puerto Rico (PROTEC), 17°57'N, 65°52'W). Such data are useful as a first approximation of natural fluctuations in the fish populations so that initial potential impacts of plant operations may be considered. The information will provide OTEC plant designers with an idea of the economic value of the fisheries in the vicinity of the proposed site. Detailed data are presented. (WHK)

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 8533, 8726, 8727, 8733, 8889, 9046, 9260, 9266, 9269, 9270, 9280, 9281, 9281, 9288, 9289, 9290, 9291, 9292, 9720

8902 (ANL/EES-TM—96(Vol.2), pp 239-245) **Solar drying of sewage sludge on an inclined plane.** Murdock, J.D. (Perlite Corp., Chester, PA). Aug 1980.

From 12. IECEC conference on energy conservation in the treatment of industrial wastewaters; New Orleans, LA, USA (10 Dec 1979).

A configuration capable of accomplishing high evaporation rates for sewage sludge at low cost is described. A twenty-five foot long open ended, glazed, inclined plane, testing apparatus was constructed and operated at Princeton University. The purpose of this work was to gain an understanding of the determinants of heat and mass transfer between parallel planes inclined from the horizontal. A model was developed mathematically and corrolated with empirical data. What resulted was a mathematical model useful for comparative purposes but not sufficiently accurate for predictive purposes. Test conditions were constant and simulated the average conditions over an eight hour February day in New Jersey. The incident radiation was constant at 716 Btu/h-yd^2, (244 Watts/m^2), with an ambient air relative humidity of 68% and a temperature of 55°F. Coal slack and two different primary sludges were tested. Test data showed that a solar dryer of this configuration is capable of achieving evaporation rates in excess of 1.28 lb/h-yd^2 across a range of moisture contents with an incident radiation of 716 Btu/h-yd^2. This amounts to 1805 Btu/h-yd^2 of energy saved by not allowing that water to be vaporized during combustion and heated to final stack temperatures of 500°F. The solar dryer has a minimum efficiency of 252% when rated in this manner.

8903 (ANL/EES-TM—115(Vol.1)) **Solar reliability and materials library. Volume 1: library overview.** Singh, H.; Wolosewicz, R.M.; Singh, I. (Argonne National Lab., IL (USA)). Sep 1980. Contract W-31-109-ENG-38. 26p. NTIS, PC A02/MF A01.

The reliability and materials library that is an integral part of the Argonne National Laboratory solar reliability and materials program is described. The design of the library, the software selection, and the data structure are explained in this volume of the report. The procedures for obtaining outputs and examples of actual outputs from the library are presented.

8904 (BNL—51259) **Solar/performance goals for solar and ground-coupled heat pump systems.** Andrews, J.W. (Brookhaven National Lab., Upton, NY (USA)). Sep 1980. Contract AC02-76CH00016. 31p. NTIS, PC A03/MF A01.

Cost goals for combined solar/heat pump systems are developed. Three methods of analysis are used: simple payback, positive cash flow, and life cycle costing. The goals are parameterized on system energy efficiency, with the air-to-air heat pump as the conventional system which is used as a basis for comparison. Cost goals for nine systems are determined in three generic climates.

8905 (CONF-800995—) **Proceedings of the Western SUN 1980 solar update.** (MCC Associates, Silver Spring, MD (USA)). 1980. 308p. NTIS, PC A14/MF A01.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

Thirty-nine papers are included. Separate abstracts were prepared for thirty-seven and one was listed by title. The paper, A Thermal and Economic Performance Comparison of Passive and Active Solar Systems with Methods Commonly Employed by Cats was not abstracted for EDB. (MHR)

8906 (CONF-800995—, pp 17-22) **Using information from the National Solar Data Network to assess long-term performance.** Doak, L.; Gervassio, C. (Automation Industries, Inc., Silver Spring, MD). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The way the NSDN data base can be used to examine performance trends for designs of interest is explained. Four examples are presented to illustrate typical long term performance information that can be obtained. (MHR)

8907 (CONF-800995—, pp 23-36) **Comparative thermal performance of passive systems in the NSDN.** Sersen, S.J. (Automation Industries, Inc., Silver Spring, MD). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The performance of three passive solar energy systems in the NSDN during the 1979 to 1980 heating season is reported. In addition, a three day cycle of both storage charging and discharging is evaluated for each site. All three passive structures analyzed are of the direct gain type. Energy storage is in water walls and slab, slab and interior mass, and lastly by a high wall with a fan forced rock bed under the house slab.

8908 (CONF-800995—, pp 37-42) **Energy savings in four solar homes: a comparative study.** Waterman, R.E. (Automation Industries, Inc., Silver Springs, MD). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The question of energy savings is addressed by studying the utility bills of four solar and four nonsolar homes in Columbia, Maryland. The utility bills are complemented by heating season data from the National Solar Data Network. Both sources of data are used to estimate energy savings in the four solar homes over three full heating seasons, from November 1977 to March 1980. Observations about the effects of installation on system performance, control system strategies and subsystem components sizing are included.

8909 (CONF-800995—, pp 49-53) **Living in a passive solar home.** Balcomb, S. (Passive Solar Associates, Santa Fe, NM). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

Experience living in a passive solar home is described, and some of the myths regading such homes are discussed. (MHR)

8910 (CONF-800995—, pp 81-86) **Making solar happen: Manufactured Buildings and Metro Denver Home Builders Programs.** Baccei, B. (Solar Energy Research Inst., Golden, CO). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The progress of the Manufactured Buildings Program is reported. The model which this program provides for government working with industry is also discussed. The innovative contracting procedures, the approach of early coordination and planning with industry association, the passive solar designs developed and the status of homes constructed under the Denver Meto Home Builders Program are reported. (MHR)

8911 (CONF-800995—, pp 87-96) **Solar upgrading of low-income housing.** Lumsdaine, E.; Farrer, R.; Miller, D. (New Mexico State Univ., Las Cruces). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

This program was responsible for the installation of 237 solar retrofits and the training of more than 100 installers. The following are discussed: barriers-educational, financial, and technical; policy issues; criteria for future renewable energy projects for low-income communities, and the economic impact of the demonstration program. (MHR)

8912 (CONF-800995—, pp 97-104) **Solar energy control systems installation and modification, and effects on system performance.** Waterman, R.E. (Automation Industries, Inc., Silver Spring, MD). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The performance of solar energy space heating systems, particularly those systems that employ heat pumps for auxiliary energy, is a sensitive function of control system installation. The cause and effect relationship between overall system performance and differing control system sensor placements in three solar homes is discussed. Control system hysteresis induced by sensor location is examined in detail. The effect of modifying the space heating delivery system in one of the homes by means of a timer is also discussed.

8913 (CONF-800995—, pp 113-114) **Filthy lucre: new approaches to solar financing.** Yudelson, J. (State of California Solar Business Office, Sacramento). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

Financial issues are listed. Consumer loans and commercial loans are discussed. (MHR)

8914 (CONF-800995—, pp 127-132) **Solar heating system for curing concrete block.** Augspurger, Q. 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

A 3200 ft^2 flat plate collector system was used to supply heat to cure concrete block. The system was designed to replace a portion of the program consumption with a two year target payback on the private capital investment. Maintenance, cost, design, and construction of the system is described. (MHR)

8915 (CONF-800995—, pp 139-145) **Solar versus heat pumps versus heat recovery.** Bean, M.E. (Cody Co., Honolulu, HI). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The economics of several large solar water heating systems in Honolulu is compared to the economics of recovering waste heat from air conditioning systems and the use of air and water source water heater heat pumps. (MHR)

8916 (CONF-800995—, pp 153-156) **Portland General Electric Company Water Heater Incentive Program (WHIP).** Boleyn, D.R. (Portland General Electric Co., OR). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The following are discussed: the background of WHIP; the economic justification of the program; standards for installations and contractors; and operational description and status of program. (MHR)

8917 (CONF-800995—, pp 157-161) **Solar energy transfer system using window collectors.** Brandle, K.; Boehm, R.F. (Univ. of Utah, Salt Lake City). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

Windows are used as air-type solar collectors in a house which was built in Riverton, Utah. The project is part of the HUD Residential Solar Demonstration Program. The collected heat is transferred to the north side of the building by means of air ducts which also contain electric resistance auxiliary heaters. When solar energy is available and heat is needed in the spaces on the north side, the heat is transported directly there. Two concrete block walls on the north facade allow storage of excess heat for later use. The system operates with electronically controlled fans and dampers. The net passive solar heat contribution is calculated to be about 37% per year. (MHR)

8918 (CONF-800995—, pp 163-171) **Solar process heat in Arizona: economic incentives and policy.** Campoy, L.; Mignon, G.; Smith, S.; Fazzolare, R. (Univ. of Arizona, Tucson). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

Solar energy utilization for process heat in commercial, industrial, and agricultural applications in the State of Arizona is discussed. The incentives and potential for solar substitution for conventional fuel are examined. (MHR)

8919 (CONF-800995—, pp 175-183) **Development and commercialization of the Phoenix system.** Jardine, D.M. (Kaman Sciences, Colorado Springs, CO). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The development of a ground coupled solar heat pump system is described. Eleven different heating and cooling system configuration were installed and tested in a highly instrumented specially built residence. The reliability of the ground coupled solar heat pump system was proved. The engineering field testing of the system is described. (MHR)

8920 (CONF-800995—, pp 191-201) **Discussion of site-built attached solar greenhouses.** Krigger, J.T. (National Center for Appropriate Technology, Butte, MT). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

Observations, discussion, and advice on the building of attached solar greenhouses are presented. Planning, construction practices, and operating systems are covered. (MHR)

8921 (CONF-800995—, pp 203-206) **Construction of passive solar homes in Wyoming.** McGee, F. (Sun-Works Construction, Cody, WY). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

Design criteria are listed for the following: site selection, building shape and orientation, north side of building, location of indoor spaces, protected entrance, window location, system choice, cost, and construction. (MHR)

8922 (CONF-800995—, pp 223-232) **Diagnosis and repair of a large solar hot water heating system: Project Sunshower.** Rigter, J.; Lennon, K.; Murphy, M. (Energy Options, San Jose, CA). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

Project Sunshower is a 9000 ft^2 hydronic solar heating system supplying hot water for 600 students in three dormitories. It is located at San Jose State University in San Jose, California. The system was built by students. The project was funded for an initial in-house cost of $150,000. The system has been in operation for three years. During this time, some plumbing and electrical failures have reduced its overall performance. This system was designed and installed at a time when there were no other operating solar heating systems of this size on which to draw practical design experience. The purpose here is to share with the solar industry the diagnosis and repair of a large hot water heating system. Project Sunshower has paid for approximately one/fifth of itself under adverse conditions.

8923 (CONF-800995—, pp 247-249) **Amity: Idaho's earth integrated, solar powered school.** Steger, H. (Amity School, Boise, ID). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The 51,400 ft^2 school building has 25 classrooms, a multipurpose room, special education services, library media center, health, lunchroom, a music room, and the usual auxiliary spaces. The concrete shell has a two foot earth cover. The solar system is a space heating and domestic hot water system using 370 ft^2 of single glazed and liquid cooled collectors with a selective surface for the hot water system and 1830 ft^2 for space heating. R-values, cost, energy savings, payback period, and the minimal problems involved are discussed. (MHR)

8924 (CONF-800995—, pp 251-252) **Hands on solar: please touch.** Stoppielo, A. (Portland SUN, OR). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

A solar water heating construction workshop is described briefly. (MHR)

8925 (CONF-800995—, pp 253-254) **Advantages of passive solar hot water systems for low income housing.** Timson, D. (Proteus Adult Training, Inc., Hanford, CA). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

A solar project is described designed for training low-income participants into solar related jobs and for providing low-income farmworker families with solar water-heating (retrofit) systems in their homes, constructed and installed by the trainees. The advantages found for passive solar water heaters in this project are summarized. (MHR)

8926 (CONF-7805216—, pp 1-10) **Solar heating system with interseasonal storage.** Todd, R.W. (National Centre for Alternative Technology, Wales, England). 1978.

From Conference on storage in solar energy systems; London, UK (5 May 1978).

The building is a conversion based on an old slate walled workshop and now houses an exhibition hall and bookshop with an office above - 200m². An internal perimeter wall was added and the building insulated with between 150 and 200 mm of polystyrene all round. A double glazed trickle type collector was used. An unconventional low cost water store design consists of a hole in the ground lined with rigid polystyrene foam and a butyl liner. (MHR)

8927 (CONF-7908116—(Vol.1), pp 7p, 79-9) **Solar space heating with Conserval Wall.** Hollick, J.C. (Conserval Engineering Inc., Toronto, Ontario). 1979.

From 5. national conference on solar energy: bringing it down to earth; Charlottetown, Prince Edward Island, Canada (18 Aug 1979).

A new concept for Solar Space Heating has been developed by Conserval Engineering called a Conserval Wall. It utilizes the simplicity of the Trombe Wall and at the same time simplifies construction techniques, significantly reduces the heat loss from the thermal storage, and provides much better room temperature control. The performance of various types of passive solar heating systems and the Conserval Wall which can be considered a hybrid system are described. Design details, cost data and pay back are presented. It is expected that the Conserval Wall will greatly reduce the cost of Solar Space Heating and will appeal to contractors and do-it-yourselfers who will find the system easy to construct and simple to operate.

8928 (CONF-7908116—(Vol.1), pp 13p, 79-12) **Integrative solar design: an explication of Raven Run.** Levine, R.S. (Univ. of Kentucky, Lexington). 1979.

From 5. national conference on solar energy: bringing it down to earth; Charlottetown, Prince Edward Island, Canada (18 Aug 1979).

As the field of solar energy utilization matures, attention turns from hardware and details to systems and design. We have only a few examples of mature solar designs where the process of integrative design has produced buildings in which energy conserving aspects are carefully integrated with other building aspects in which the resulting designs are quantitatively and qualitatively better as a result of this integration. The Raven Run Solar House is a project where the integration of active and passive solar heating systems with the fabric of the building's construction creates a work of architecture that is attractive, energy efficient and cost effective. Some of the design relationships that have generated these effects are described. By so doing it demonstrates that design, in general, and energy conscious design, in particular, must be a process of integration of concepts and details, and not an addition of effects.

8929 **(DOE/CS/30108—T3) Coordination and management tasks for the IEA solar heating and cooling program and CCMS solar energy pilot study. Final report.** Blum, S.B.; Kennish, W.J. (TPI, Inc., Beltsville, MD (USA)). Oct 1980. Contract AC02-79CS30108. 36p. (TPI/IEA/F—7). NTIS, PC A03/MF A01.

The objective of the project entitled, Coordination/Management Tasks for the IEA Solar Heating and Cooling Program and CCMS Solar Energy Pilot Study, was to provide support to DOE in connection with the afore-named multilateral cooperative projects. The work included both management assistance for the overall IEA and CCMS projects and technical involvement in IEA Task I, particularly the solar system performance validation effort. The final report, covering the period March 15, 1979 - September 30, 1980, provides an overview of the accomplishments under this contract and gives conclusions and recommendations for future work. Also included in this document is the final project status report for the period May 15, 1980 to September 30, 1980.

8930 **(DOE/CS/34127—1) Winter experience of a passive solar retrofit. Final technical report.** Michels, T.I.; Andes, F.S. (Londe-Parker-Michels, Inc., St. Louis, MO (USA)). 23 Dec 1980. Contract FG04-77CS34127. 8p. (CONF-801218—3). NTIS, PC A02/MF A01.

From Colloque solaire international; Nice, France (11 Dec 1980).

An older home in St. Louis had 2 inch foam insulation added to the outside of masonry walls with stucco exterior finish applied. The south wall was modified so that there is a gross solar collection area of 26.2 m², with 13.2 m² of greenhouse, 8.6 m² of direct gain and 4.4 m² of Trombe components. The performance of the building and its data acquisition system are described. (MHR)

8931 **(DOE/CS/35351—T1) Evaluation of solar collectors for heat pump applications. Final report.** (American Heliothermal Corp., Denver, CO). Aug 1980. Contract AC04-78CS35351. 154p. NTIS, PC A08/MF A01.

The study was initiated to evaluate the potential utility of very low cost (possibly unglazed and uninsulated) solar collectors to serve as both heat collection and rejection devices for a liquid source heat pump. The approach consisted of exercising a detailed analytical simulation of the complete heat pump/solar collector/storage system against heating and cooling loads derived for typical single-family residences in eight US cities. The performance of each system was measured against that of a conventional air-to-air heat pump operating against the same loads. In addition to evaluation of solar collector options, the study included consideration of water tanks and buried pipe grids to provide thermal storage. As a supplement to the analytical tasks, the study included an experimental determination of night sky temperature and convective heat transfer coefficients for surfaces with dimensions typical of solar collectors. The experiments were conducted in situ by placing the test apparatus on the roofs of houses in the Denver, Colorado, area. (MHR)

8932 **(DOE/NASA/CR—161605) Solar domestic hot water system installed at Texas City, Texas. Final report.** (LaQuinta Motor Inns, Inc., San Antonio, TX (USA)). Dec 1980. Contract AI01-76ET20191. 30p. NTIS, PC A03/MF A01.

The Solar Energy System located at LaQuinta Motor Inn, Texas City, Texas was designed to supply 63% of the total hot water load. The Solar Energy System consists of a 2100 square foot Raypack Liquid Flat Plate Collector Subsystem and a 2500 gallon storage subsystem circulating hot water producing 3.67 x 10^8 Btu/y. Abstracts from the site files, specification references, drawings, installation, operation and maintenance instructions are included.

8933 **(DOE/SF/12989—1) Development of a market methodology for assessing the impact of solar thermal-produced fuels and chemicals.** Swanson, C.A. (Technical Research Analysis Co., Falls Church, VA (USA)). 17 Nov 1980. Contract AP03-80SF12989. 59p. NTIS, PC A04/MF A01.

Two papers are included. A separate abstract was prepared for each one. (MHR)

8934 (DOE/SF/12989—1, pp 1-11) **Market assessment methodology for solar thermal-produced fuels and chemicals.** 17 Nov 1980.

In Development of a market methodology for assessing the impact of solar thermal-produced fuels and chemicals.

An attempt was made to determine the potential impacts on the solar thermal industry and on the markets for particular fuels and chemicals of applying solar thermal technology to the production of these fuels and chemicals. The following are covered: the technical compatibility of Solar Thermal Fuels and Chemicals (ST/FC) processes, the identification of promising ST/FC processes, technical specification and economic evaluation of selected systems, ST/FC market assessments, and identification of strategic options. (MHR)

8935 (DOE/SF/12989—1, pp 12-35) **US oil shale resource and potential for application of solar thermal technology.** 17 Nov 1980.

In Development of a market methodology for assessing the impact of solar thermal-produced fuels and chemicals.

An overview is presented of oil shale resources, economics, and industry development, and of issues significant to the potential application of solar thermal technology in oil shale retorting. (MHR)

8936 **(EPRI-EM—1654) Solar-heated hot water instrumentation project for EPRI Headquarters complex, Palo Alto, California. Final report.** Whitehouse, H.T.; Ortiz, P. (Pacific Sun, Inc., Palo Alto, CA (USA)). Jan 1981. 172p. NTIS, PC A08/MF A01.

A data acquisition and analysis effort charted the performance of a solar-assisted, hot water preheat system supplying a portion of the service water needs at the EPRI Headquarters complex in Palo Alto, California. The project commenced in June of 1978, with active data acquisition transpiring over a 12-month period from December 1, 1978, to November 30, 1979. Detailed load and performance data for the system are presented, the merits of the data acquisition system employed are discussed, and recommendations for future monitoring efforts are provided.

8937 **(LA-UR—80-3453) Performance evaluation of the Balcomb solar house.** Balcomb, J.D.; Hedstrom, J.C.; Perry, J.E. Jr. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 10p. (CONF-801218—4). NTIS, PC A02/MF A01.

From Colloque solaire international; Nice, France (11 Dec 1980).

Additional instrumentation was added to the Balcomb solar house for a six-week period and up to 85 channels were recorded hourly. Some new findings based on an evaluation of these data are presented. (1) The thermal comfort characteristics of four rooms are documented. (2) Relative humidity in the living room varies from 30 to 50%; these data are used to infer an evaporation rate in the house of about 25 kg of water/day. The evaporation rate correlates reasonably well with greenhouse temperature. (3) Heat storage in the greenhouse floor is estimated at about 0.30 kWh/day-m^2 based on temperatures measured at four depths. (4) Several thermal characteristics of the rock bed are deduced but it is evident that the heat flow is not yet completely understood.

8938 **(LA-UR—80-3473) Development of simplified design aids based on the results of simulation analysis.** Balcomb, J.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 9p. (CONF-801218—2). NTIS, PC A02/MF A01.

From Colloque solaire international; Nice, France (11 Dec 1980).

The Solar Load Ratio method for estimating the performance of passive solar heating systems is described. It is a simplified technique which is based on correlating the monthly solar savings fraction in terms of the ratio of monthly solar radiation absorbed by the building to total monthly building thermal load. The effect of differences between actual design parameters and those used to develop the correlations is estimated afterwards using sensitivity curves. The technique is fast and simple and sufficiently accurate for design purposes.

8939 **(SAN—1218-4) Solar production of industrial process hot water: operation and evaluation of the Campbell Soup hot water solar facility. Final report, September 1, 1979-December 10, 1980.** Kull, J.I.; Niemeyer, W.N.; Youngblood, S.B. (Acurex Corp., Mountain View, CA (USA). Alternate Energy Div.). Dec 1980. Contract AC03-76CS31218. 162p. NTIS, PC A08/MF A01.

The operation and evaluation of a solar hot water facility designed by Acurex Corporation and installed (November 1977) at the Campbell Soup Company Sacramento, California canning plant is summarized. The period of evaluation was for 12 months from October 1979 through September 1980. The objective of the work was to obtain additional, long term data on the operation and performance of the facility. Minor modifications to the facility were completed. The system was operated for 15 months, and 12 months of detailed data were evaluated. The facility was available for operation 99% of the time during the last 8 months of evaluation. A detailed description of the solar facility and of the operating experience is given, and a summary of system performance for the 12 month operation/evaluation period is presented. Recommendations for large-scale solar facilities based on this project's experience are given, and an environmental impact assessment for the Campbell Soup solar facility is provided. (WHK)

8940 **(SAND—80-2526) Pump heat loss test report.** Quintana, M.A.; Torkelson, L.E. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 23p. NTIS, PC A02/MF A01.

A test is described which measures the heat loss from a centrifugal pump under both insulated and uninsulated conditions. Results showed a 27% reduction in loss by insulating the pump and seal not requiring liquid cooling.

8941 **(SAND—80-8234) Survey of US industrial process heat usage distributions.** Iannucci, J.J. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 30p. NTIS, PC A03/MF A01.

The potential for penetration of solar thermal energy into the industrial process heat (IPH) market depends upon many factors, prominent among which are the energy use characteristics of industry. Although the overall IPH market is large, there is presently very little known about typical size and temperature combinations which will be required. Using recently published data on 1972 United States industrial energy consumption (grouped by standard industrial classifications) and the number of energy consuming establishments, estimates can be made of average consumption rate (megawatts) of energy at any site. Incorporating known temperature requirements for those industrial types, the power ratings required at various temperatures can also be calculated. Combination of these data yields distributions of energy consumption facility sizes at various temperatures. In terms of number of facilities, the small, lower temperature end users dominate. However, in terms of total energy consumed, the larger users (10 MW thermal and above) and higher temperatures dominate.

8942 **(SOLAR/1030—80/50) Solar project description for Chester West single dwelling - Huntsville, Alabama.** Moore, D. (Boeing Co., Huntsville, AL (USA)). 23 Oct 1980. Contract AB01-76CS31020. 62p. NTIS, PC A04/MF A01.

The Chester West solar energy system is installed in a single family dwelling located in Huntsville, Alabama. The system is designed to provide solar energy for space heating and domestic hot water. Solar energy is collected by flat plate collectors with 226 square feet. The collector banks are mounted on the roof of the house and face due south at an angle of 49 degrees to the horizontal optimizing solar energy collection. Solar energy is transferred from the collector array to a 500-gallon storage tank. Water is used as the heat collection, transfer and storage medium. Freeze protection is provided with a Glycerol-Water mixture. Solar energy is circulated to the conditioned space by solar heated water from storage through a liquid-to-air heat exchanger, located in the air distribution duct. Auxiliary space heating is provided by an air to air heat pump and electrical elements. Auxiliary domestic hot water is provided by electrical elements in the DWH. The dwelling has been fully instrumented for performance evaluation since September 1977 and the data is integrated into the National Solar Data Network. Original cost estimates for provisioning and installation of the solar system are given.

8943 **(SOLAR/1041—80/50) Solar project description for Forest City Dillon highrise apartments, Washington, DC.** (Boeing Co., Seattle, WA (USA)). 30 Oct 1980. Contract AB01-76CS31020. 54p. NTIS, PC A04/MF A01.

The Forest City Dillon site is a high-rise apartment building in Washington, DC. The building has 188 apartments and a total of 124,000 square feet of living space. Solar energy is used only to preheat the domestic hot water (DHW). Six individual apartments are instrumented with flowmeters; however, the flow data is not used in the performance evaluation. The solar energy system has 12

arrays of flat-plate collectors with a gross area of 2592 square feet. The arrays face south at an angle of 40° to the horizontal. A synthetic oil (parafinic) is the transfer medium that delivers solar energy from the collector arrays to a hot-water heat exchanger. Preheated water is stored in a 3200-gallon storage tank and supplied, on demand to a conventional 400-gallon hot water tank. When solar energy is insufficient to satisfy the total load, three oil-fired boilers provide auxiliary thermal energy. The dwelling has been fully instrumented for performance evaluation since July 1977 and the data is integrated into the National Solar Data Network. Original cost estimates for provisioning and installation of the solar system are given.

8944 **(SOLAR/2012—80/14) Bell Telephone of Pennsylvania, West Chester, Pennsylvania: solar energy system performance evaluation, November 1979-March 1980.** Frock, S.J. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1980. Contract AC01-79CS30027. 75p. NTIS, PC A04/MF A01.

The Bell Telephone Company of Pennsylvania office building has 2112 ft^2 of flat-plate collectors and a 4600 gallon steel tank for heat storage. During the period reported the system had a 46% solar fraction and a coefficient of performance of 30. (MHR)

8945 **(UCRL—53063) Solar gasification of carbonaceous materials.** Taylor, R.W.; Berjoan, R.; Coutures, J.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1980. Contract W-7405-ENG-48. 39p. NTIS, PC A03/MF A01.

Charcoal, wood, and paper have been gasified in a packed-bed reactor using steam and solar energy. The steam was generated by spraying water directly onto the surface of the fuel and, at the same time, heating the fuel at the focus of a solar furnace. The steam was generated by solar energy. Half of the steam reacted with carbon, and 30% of the incident solar energy was stored as chemical energy. The performance of a fluidized-bed reactor was compared to that of a packed-bed reactor using charcoal and CO_2. The fraction of the incident solar energy utilized to produce CO (stored) was 10% in the case of the fluidized-bed reactor and 40% for the packed-bed reactor. The fuel value of the gas produced from the steam-gasification of wood and paper was 65 kcal/mole (320 Btu/lb). The volume yield of the gas was 1 +- 0.1 m^3/kg (on an ash-free basis).

8946 **Field comparisons of passive/phase change fluid with active/liquid domestic hot water systems.** Manasse, F.K. (Univ. of New Hampshire, Dover); Goodman, H.; Macfarlane, A. pp 958 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

8947 **Analysis of solar water heating systems.** Buckles, W.E.; Klein, S.A.; Duffie, J.A. (Univ. of Wisconsin, Madison). pp 959-963 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Detailed computer simulation programs are available which may be used to model the performance of a specified solar domestic water heating system. Simulations, however, are not convenient for routine design because they require hourly meteorological data and a fair amount of expertise. An improvement on this situation is the f-chart design method which provides estimates of monthly average system performance based on system design and monthly average weather data. The f-chart method was derived for two-tank systems in which the preheat tank has a fixed amount of insulation and the auxiliary tank is perfectly insulated. The use of a tempering valve was not considered. In addition, a fixed daily load distribution was assumed. A study of the comparative performance of four common types of solar domestic water heating systems is presented. The purpose of this study is to determine the applicability of the f-chart method for the design of the various types of solar water heating systems now available. Results are presented and discussed. (WHK)

8948 **Design and evaluation of solar installation workshops and the HUD solar DHW installation guidelines.** Hollander, P.; O'Neill, M. (Franklin Research Center, Philadelphia, PA). pp 964-966 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

An analysis of 31 workshops, held as part of HUD's Residential Hot Water Initiative is made. Installation Guidelines for Solar DHW Systems emerged as an outgrowth of that program and is reviewed here.

8949 **Performance vs prediction for four classes of solar hot water systems.** Bergman, J.G. (Univ. of Delaware, Newark). pp 967-971 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

An analysis of the actual performance of representatives of several classes of hot water systems in terms of Btu's delivered and fraction of energy requirements met under representative load patterns and comparison by extrapolation of this performance to predicted values will be presented. Multiple regression techniques are used to quantify the extent to which performance is related to the mean and deviation of insolation and synoptic weather data. The regression coefficients can be used to give some comparison of the relative sensitivities to input of the different systems. Finally, through utilization of actual long-term weather data, it is possible to predict long-term expectations on the basis of actual transient performance. More accurate predictions based on actual performance and correlated to actual weather data will permit more precise analyses of economic savings and improved acceptance by the consuming public. Such analysis should help resolve the questions raised by many investigators regarding the proper selection for weather data in simulation models. Knowledge of expected short-term behavior would provide a means by which to establish performance standards and permit the identification of substandard performance within a short period of time.

8950 **Experimental system performance and comparison with computer predictions for six solar domestic hot water systems.** Fanney, A.H.; Liu, S.T. (National Bureau of Standards, Washington, DC). pp 972-976 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Currently three computer programs, F-CHART, SOLCOST, and TRNSYS, are being extensively utilized for the design and evaluation of solar space heating and domestic hot water systems. Although widely used, the accuracy of their predictions needs to be verified with experimental data. In order to provide data required for the validation of these computer codes for solar domestic hot water (SDHW) systems, the staff at the National Bureau of Standards has fabricated and instrumented a solar hot water test facility at its Gaithersburg, Maryland site. The test facility and experimental results are described, and the experimental results are compared with the computer predictions for the first eight months of operation.

8951 **Thermal performance of solar water heaters in the UK.** Rosenfeld, J.L.J. (Shell Research Ltd., Chester, UK). pp 977-981 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

As a contribution to the preparation of a code of practice by the British Standards Institution technical committee on solar water heaters, the long-term thermal performance of domestic solar water heaters has been estimated, using a computer program developed at Thornton Research Centre. This model is described, and results are presented showing the effect on thermal performance of varying some system parameters. The results are consistent with those obtained by others using models incorporating different kinds of approximations, and with the scant experimental data.

8952 Simulation models applied to the design of a novel domestic water heater. Armstrong, P.R.; deWinter, F.; Morrison, D.J. (Altas Corp., Santa Cruz, CA). pp 982 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

8953 Mean monthly performance of solar water heaters with natural circulation. Daneshyar, M. (Univ. of Technology, Isfahan, Iran). pp 983-987 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The predictions of the transient performance of a natural circulation solar water heater obtained by a theoretical method have been compared with experimental data. The comparisons have shown that transient and final system temperatures can be predicted with an accuracy of about 10%. The prediction method has, therefore, been used in order to study the mean monthly performance of a natural circulation solar water heater with no drawoff at a particular location, and the predicted instantaneous values of the mean storage tank temperatures and collection efficiencies for a mean day of each month are presented and discussed.

8954 Solar plus waste heat recovery hybrid water heating system. Pitkin, E.T. (Univ. of Connecticut, Storrs). pp 988-992 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The potential of combining heat recovery from waste water with a solar hot water system is examined via computer simulation. The simulation program is first verified by comparison with data from a real solar water heater. It is then used to show that approximately one third of domestic water heat can be obtained from waste hot water.

8955 Design of the solar water heater system for TVA's Memphis Initiative. Carney, T.M.; Robertson, F.R. (Tennessee Valley Authority, Chattanooga). pp 993-997 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The design constraints imposed on solar water heaters by requiring off-peak electrical auxiliary power are described. A two-tank system satisfying these constraints is proposed, and components are sized using the FCHART simulation and a life cycle return criterion. Experimental confirmation of the off-peak auxiliary performance is included. The system resulting from the study is being used in TVA's Memphis Initiative.

8956 Photovoltaic-powered solar domestic water heater. Chandra, S.; Litka, A.H. (Florida Solar Energy Center, Cape Canaveral). pp 998 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

8957 Development and demonstration of a solar pond for heating greenhouses. Short, T.H.; Badger, P.C.; Roller, W.L. (Ohio Agricultural Research and Development Center, Wooster). pp 1021-1025 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A solar pond built at the Ohio Agricultural Research and Development Center (OARDC) during the summer of 1975 was designed to demonstrate space heating a commercial greenhouse. Another greenhouse of the same size and shape was heated with natural gas and compared to the solar-pond-greenhouse system. Since 1975 the solar pond has been tested and modified to improve its reliability and efficiency and a polystyrene-pellet nighttime-insulation system is under development for large greenhouses. This new combination is projected to provide all the greenhouse heat by passive and active solar technology. However, some solar pond operational problems still exist which are discussed.

8958 Solar energy system with heat pump augmentation for industrial process heat: an update. Schuler, H.F.; Rost, D.F.; Ameduri, G. (General Extrusions, Inc., Youngstown, OH). pp 1034-1036 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

In September 1977, General Extrusions completed installation of a solar energy system with heat pump augmentation to furnish power for a cleaning tank in their aluminum anodizing line. The array was 100 modules (304 m^2) of their Model LTC-367 Solar Collector and the heat pump was a Westinghouse Templifier TBP060. During the last 261 days the solar system has been operated 83 days supplying energy to the process. Thirty-one days of potential operation were missed as the plant operated on a five day a week schedule much of the time. A minicomputer-based energy monitor system is under construction for this solar system and will give detailed operational results as well as automatic control.

8959 Operation of an industrial solar drying system. Carnegie, E.J.; Niles, P.W.; Stine, W.B. (California Polytechnic State Univ., San Luis Obispo). Contract EY-76-C-05-5123. pp 1037-1041 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

California Polytechnic State University, San Luis Obispo, under the Industrial Process Division of Department of Energy, assisted by TRW (Energy Systems Group) of Redondo Beach, and Pacific Gas and Electric Company, has designed, constructed and is operating an industrial hot air raisin and prune drying system at the Lamanuzzi and Pantaleo Plant in Fresno, California. The solar heating system consists of 1951 m^2 (21,000 sq ft) of solar collectors, a 396 m^2 (14,000 cu ft) rock storage facility and a heat recovery unit. The system was placed in operation during the drying season from August 1978, to mid-January 1979, and supplied about 80% of the heating requirements for one drying tunnel. The operations of the system are described and the actual operation is compared on a day to day basis to a computer simulation program which was used in the analysis and design phases of the project. Also an analysis is made of the energy embodied in the system and the length of time required to recapture this energy cost.

8960 Application of solar energy to food industry: a distillery. Moisan, F. (Equipe Techniques de Base du Pirdes, Paris, France). pp 1042-1045 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The use of concentration collectors will permit production of steam for various industrial processes, especially in the food industry. A project, presently developed in France, is applied to a distillery; 5000 m^2 of collecting area will save 360 tons of fuel per year; the cost of collectors, it they are mass produced, will permit the competitiveness of solar heat versus fuel at middle term.

8961 Prototype of solar linear concentrators plant installed to supply industrial heat. Barra, O.A. (Universita di Calabria, Italy); Barutti, A.; Carratelli, B.P. pp 1046-1050 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A 50 m^2 solar linear concentrators plant has been realized in the Birra Peroni Italian brewery to verify the problems arising in a real application of solar energy exploitation to supply industrial heat in the range of 120 to 300°C before designing a large size plant. The peculiar aims of this experimental plant are: (a) to test a mathematical computer model, previously carried out, by means of experimental measurements in order to obtain a general computer code useful to design these plants; (b) to measure the plant conver-

sion efficiency; (c) to solve the problems deriving from jointing the solar plant with the pre-existing brewery water-steam network. In the present paper the plant is described, the arguments (a), (b) and (c) are introduced and the preliminary results obtained are shown.

8962 **Solar energy for kilning malt.** Smith, C.C. (Colorado State Univ., Fort Collins). pp 1051-1055 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A technical and economic feasibility study was conducted at Colorado State University on the use of solar energy for kilning malt. The study showed that an economic optimum results when the kiln cycle peak demand coincides with the maximum solar output. Therefore the objective of the system design study was to maximize the use of solar supplied heat by scheduling kilning operations with regard to the diurnal solar period.

8963 **Solar heat generation for industrial process heating applications.** Read, W.R.W. (CSIRO Division of Mechanical Engineering, Victoria, Australia). pp 1056-1060 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The urgent energy requirement facing Australia is the need to develop alternative energy resources as replacements for oil in transportation and in domestic, commercial and industrial applications. Solar energy is one possibility. The use of solar energy in industrial applications is discussed. Some of the characteristics of industrial systems are outlined, and the design approaches, together with results to date, are discussed.

8964 **Survey of simplified design methodologies for solar heating and cooling systems.** Hughes, P.J.; Versteegen, P.L. (Science Applications, Inc., McLean, VA). Contract AC04-78CS34261. pp 1199-1202 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The approaches that have been taken in developing simplified design procedures for assessing the performance of solar heating and cooling systems are reviewed. The term simplified is indicative of a calculational process that involves simple hand computational tools, such as tables, graphs, equations, and a hand-held calculator. Many methods have been proposed in the literature applicable to the analysis of heating and hot-water systems. Few methods have been proposed for the analysis of cooling systems, passive systems, and photovoltaic systems. Furthermore, few of the methods have been tested extensively against experimental data. Insight is provided to the basic, underlying assumptions of the proposed methods so that the reader better understands the applicability of each to the performance prediction of various systems.

8965 **Simplified solar cooling design method for closed-loop liquid systems.** Anand, D.K.; Abarcar, R.B.; Allen, R.W. (Univ. of Maryland, College Park). Contract EY-76-S-05-4976. pp 1203-1207 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

At the present state-of-the-art, solar cooling system performance can be predicted only by using a detailed computer simulation. A simulation program, SHASP has been successfully used in solar cooling systems analysis. However, since not all designers have access to computers that can handle detailed simulation, a viable alternative is a simplified cooling design method derived from the correlation of detailed simulation results. One such correlation is the cooling fraction, f/sub c/-chart developed using SHASP. The f/sub c/-chart can be used to predict solar cooling contribution to within 5% of the actual SHASP result, and as such can be a very useful design tool.

8966 **Cooling system parameter analysis.** Bremner, P.S.; Ward, D.S.; Loef, G.O.G. (Colorado State Univ., Fort Collins). pp 1213-1217 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Due to the high operating temperatures of absorption chillers, solar cooling systems have exhibited low efficiencies. One of the causes for the low efficiencies is heat losses from system loop piping. Another source of system inefficiencies is the thermal capacity of the pipe and fluid which requires a large amount of energy to increase the initial fluid temperature to the system operating temperature. These two system effects can total over thirteen percent of the collected solar energy in a typical system. The effects of these losses are presented.

8967 **Theoretical study of gas heated in a porous material subjected to a concentrated solar radiation.** Olalde, G. (Laboratoire d'Energetique Solaire, Odeillo, France); Peube, J.L.; Daguenet, M. pp 1355-1358 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The study is realized in steady state conditions for constant physical properties of the fluid and the solid material; the radiative fluxes are supposed to be uniform on the front surface of the porous medium. The temperature profiles T^+ (dimensionless solid temperature) and Θ^+ (dimensionless gas temperature) in function of X^+ (dimensionless distance) are determined from a system of adimensional equations composed of one differential equation of order 4 and another one of order 2 with constant coefficients. An experimental reactor was realized for the verification of the model. It was designed to be used with the 6.5 kW solar furnace of the National Center of Scientific Research in Odeillo, France.

8968 **Users group for central receiver testing.** Smith, F.B. (STTF Users Association, Albuquerque, NM); Hildebrandt, A.F. pp 1372-1376 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The structure, operation, budget, and responsibilities of the Solar Thermal Test Facilities Users Association are described. Primary responsibilities include experiment management of the Solar Thermal Test Facilities (STTF), STTF information dissemination, and providing funding for STTF Users. Facilities managed by the user group include the Sandia Central Receiver Test Facility, the Georgia Tech 400-kW thermal central tower facility in Atlanta, the solar furnace operated by the US Army at White Sands, New Mexico, and the French CNRS solar facilities in Odeillo, France. The types of high-temperature solar experiments of interest to the Users Association, which include experiments in steam and hot gases for process heat, solar chemicals and fuels, and chemical transmission of energy, are discussed. (WHK)

8969 **Mini-computer-based energy monitor system.** Schuler, H.F.; Rost, D.F.; Ameduri, G. (General Extrusions, Inc., Youngstown, OH). pp 1408-1410 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A mini-computer-based energy monitor system is under development for the solar industrial process heat system at General Extrusions, Youngstown, Ohio. The design goals are low cost, reasonable accuracy, control capability, coherent presentation of results, and sufficient hardware and software understanding to allow customization to this application as well as demonstrating the generic capabilities for energy monitor systems for Ohio industries. The major components are from the Heath Company, Benton Harbor, Michigan, because they offer a wide range of components specifically designed to work together and excellent hardware and software documentation. The temperature and flow sensors have not yet been specified. The work is supported by the Ohio Department of Energy.

8970 Pin programmable controller for research systems. Bechtel, T.N. (Colorado State Univ., Fort Collins); Armstrong, P.R.; Karaki, S.; Murphy, G.D. pp 1411-1415 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A pin programmable logic array based controller has been designed and assembled specifically to accommodate the control needs of a solar heating and cooling research and development facility. The controller is suitable for systems covering a wide range of configurations and operating strategies and facilitates control changes with a diode pin programmable logic array. This logic element allows the user to establish the desired relationship between inputs (usually temperatures) and outputs (system components) according to control criteria by insertion of diode pins into the appropriate location of the logic array board. A prototype has been installed and used in the experimental parallel heat pump, solar air heating and cooling system of CSU Solar House II during the 1978 to 1979 heating season. Experience has confirmed operation of the control unit according to design specifications.

8971 Development of an Ambient Temperature Observer/Predictor (ATOP) for use with solar heating systems. Hays, D.K. (Solar Environmental Engineering Co., Fort Collins, CO); Parkinson, B.W.; Winn, C.B. pp 1416-1420 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

There has been a considerable amount of interest in the use of off-peak storage devices and/or heat pumps with solar heating systems. The control of such devices can lead to significant savings in fuel use if the future values of the ambient temperature are accurately predicted. Both a methodology, and hardware for implementation of the methodology, have been developed for accurately predicting ambient temperatures for up to 24 hours in advance. This system is referred to as the ATOP system, an acronym for Ambient Temperature Observer/Predictor. The methodology and applications are described. Also presented are some prediction results which are directly applicable to improved control of off-peak storage devices.

8972 Optimal and sub-optimal control strategies and sensitivity study for solar liquid collector systems. Orbach, A.; Fischl, R.; Herczfeld, P.R.; Konyk, S. Jr. (Drexel Univ., Philadelphia, PA). Contract E-8-77-5-02-4512. pp 1421-1425 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The control of liquid flow in the collector loop for solar heating application is studied. The purpose of the study is three fold: first a dynamic model which accurately reflects the dynamic behavior of the solar collector is given; second, an optimal and suboptimal control strategy which maximizes the net usable energy is obtained using this dynamic model; and third, the implementation of the suboptimal policy via a thermostat on/off controller is investigated. Specifically, criteria are given for the selection of the control set points.

8973 Control systems for interfacing solar agricultural dryers with other energy sources. Schlag, J.H. (Georgia Inst. of Technology, Atlanta); Sheppard, A.P.; Baird, W.E.; Wood, J.M. pp 1426-1428 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

In order to interface a solar agricultural dryer with a biomass-fueled heater for backup, a mathematical model is developed. The parameters of interest are defined and their interrelationships discussed.

8974 Design and development of programs to optimize the control, monitoring and functional analysis of the U of L Solar Research Center. Schmitt, N.; Jones, W.R.; Murray, T.M. Jr. (Univ. of Louisville, KY). pp 1430-1434 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The University of Louisville Solar Energy Research Project (ULSERP) was developed to determine the feasibility of solar power as a source of energy in the Kentuckiana area. The administration building of the University's observatory was chosen to be used as an experimental solar energy research facility. The building has 1850 square feet of floor space and has both solar heating and cooling augmentation systems.

8975 Measurements of performance and efficiency of solar energy systems. Suter, J.M.; Kesselring, P. (Swiss Federal Institute for Reactor Research, Wuerenlingen). pp 1435-1439 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

In order to: (1) estimate the actual potential of solar energy systems of different types (including heat pumps) in Switzerland, (2) realize the problem areas in commercially built systems, and (3) gain experience for establishing highly needed recommendations for architects and engineers, we have started systematic measurements on many solar systems throughout Switzerland. A microprocessor controlled data acquisition system has been developed on a modular basis. The data are recorded on a cassette recorder. The measurements are limited to the information that allows the calculation of energy balance and efficiency of the studied systems and the detection of defects in the control device. It is pointed out that all systems are studied under actual service conditions.

8976 Performance data from reduced levels of instrumentation in solar heated and/or cooled buildings. Packard, C.J. (Alternative Energy Resources, Inc., El Paso, TX); San Martin, R.L.; Fenton, D. pp 1445-1449 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

It is recognized that the construction rate of solar heated and/or cooled buildings has dramatically increased in the United States during the past few years. Parallelling this increase has been an increase in the need for basic comparative evaluations of these solar systems. Differences in solar system types, building construction, and geographic conditions are significant enough to make virtually every solar installation of individual experimental interest. Clearly, this need for performance data has outstripped the resources available for the comprehensive monitoring of this large and rapidly growing number of solar installations. A methodology of instrumentation system design which supports multiple levels of hardware complexity and associated cost and allows valid performance comparisons to be made between solar buildings employing these different levels of instrumentation is developed. A case study of the New Mexico Department of Agriculture Building is presented which illustrates the use of this methodology.

8977 Monitoring solar heated houses in the European community: procedures, results and activities. Lush, D.M. (Ove Arup Partnership, London, England). pp 1453-1457 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The evaluation of solar heating systems in domestic premises is covered, for a wide range of climatic conditions, varying building standards and different occupancy patterns. The strategies for obtaining the necesssary information are defined. The theoretical and practical requirements of monitored projects which have already been examined are discussed, together with some alternatives for possible future projects.

8978 Solar energy applied to the needs of sub-Sahara Africa. Walton, J.D. Jr.; Bomar, S.H. Jr. (Georgia Inst. of Technology, Atlanta). pp 1465 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

8979 Characteristics of rural energy demand and major barriers and tasks and implementation of potentially viable solar technologies. Gururaja, J. (Department of Science and Tech., New Delhi, India); Ramachandran, A. pp 1466-1470 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Certain critical issues concerning the implementation of solar technologies in rural and semi-rural areas of developing countries are discussed taking the Indian situation as an example. Major barriers and tasks and implementation strategies are also discussed in the light of energy needs corresponding to various activities in the rural areas.

8980 Solar energy in Africa: survey of needs and activities; potential applications of small solar energy systems. Sloop, J.L. (PRC Energy Analysis Co., McLean, VA); Watt, M.H.; Gordon, J.J. pp 1471-1474 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

This two-part study consists of a survey of solar energy activities in eight African countries and an assessment of specific energy needs of a typical African village. The African countries of Kenya, Cameroon, Nigeria, Niger, Ivory Coast, Senegal, Mauritania, and Mali, though differing in climate and economic and energy resources, have similar electric energy needs. Not surprisingly, the greatest need for solar energy was in rural applications. The survey showed photovoltaics to be the most promising solar energy technology for meeting the electric power needs of remote African villages. In the case study of the African village, three solar technologies - photovoltaics, wind, and solar thermal - were considered for meeting the village's electric energy requirements.

8981 Social aspects of solar energy in an underdeveloped country: Guatemala. Estrada, H.R.P. (Centro Mesoamericano de Estudios sobre Tecnologia Apropiada, Guatemala). pp 1480 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

8982 Prospects for solar cooling applications in Nigeria. Ajakaiye, B.A. (Univ. of Ife, Nigeria). pp 1481-1484 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Nigeria has been slow in joining the increasing activity in the field of solar energy. The government has only recently started formulating a comprehensive energy policy. It is expected that solar energy will form a significant part of this policy. The prospects for solar cooling applications in Nigeria are discussed. Nigeria is in the tropics and the weather is favorable for solar cooling applications. It is argued that the structure of the Nigerian society is such that large air-conditioning units for public use rather than small household units should be developed at the present time. The most promising use of solar refrigeration is in the preservation of agricultural products. The pre-conditions for the successful adoption of solar cooling devices are discussed. A brief description is given of the development of a solar cooling system at the University of Ife.

8983 Effect of dye on solar distillation: analysis and experimental evaluation. Rajvanshi, A.K.; Hsieh, C.K. (Univ. of Florida, Gainesville). pp 1511 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

8984 500 gallons per day hybrid desalination plant using wind/solar energy. Lumsdaine, E.; Tag, I. (New Mexico Solar Energy Inst., Las Cruces, NM). pp 1512-1516 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

An analysis of a modular wind/solar distillation plant is presented. The design is based on a constant year-round demand of 500 gallons per day. In arid areas where wind power is available, cost analysis shows that the hybrid system is economically feasible compared with electricity which could only be generated from a conventional source such as a diesel engine. Solar stills are of the basin type while the wind energy conversion system is a horizontal axis type. The selection of the type of wind machine (whether constant speed or variable speed) depends on the meteorological conditions and the frequency of water demand.

8985 Regional comparative analysis of residential passive solar systems: thermal storage walls and direct gain. Roach, F. (Los Alamos Scientific Lab., NM); Ben-David, S. pp 1521-1525 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Various studies have indicated the desirability of passive designs from both an economic and operational standpoint, but many engineering, design, and economic parameters must be controlled to enable consistent comparisons. The LASL/UNM economic performance code has been developed to evaluate the financial attractiveness of solar heating systems under such controlled conditions. Two generic passive space heating designs are analyzed here: thermal mass storage walls and direct gain. Both masonry (Trombe) and water storage mediums in the thermal mass storage concept are considered. The economic performance of these passive systems is evaluated on a detailed regional basis (208 sites) throughout the contiguous United States. A fairly standard single-story family residence with locally-specified space heating load characteristics is used for each site. For each of the conventional energy types considered - electricity and natural gas, sensitivity analysis is conducted to determine the maximum competitive solar add-on costs for each passive system under a set of specified alternative energy price, solar performance, and economic conditions.

8986 Thermopond applicability to climate and structure. Hay, H.R. (Skytherm Processes and Engineering, Los Angeles, CA). pp 1535-1539 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Collection, storage, dissipation and transfer of heat from Thermoponds with movable insulation have newly recognized potentials for solar heating, for replacing air conditioners, and for lessening peak power demand. The state-of-the-art for Skytherm natural heating and cooling of residential and commercial buildings is presented; fire protection and sound control are additional assets. Designs for high seismic, wind, and Thermopond loads are adapted in several illustrated architectural and structural forms.

8987 Characterization of the performance of passive solar heating systems. Clausing, A.M.; Drolen, B.L. (Univ. of Illinois, Urbana). pp 1540-1544 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A method is presented for defining and quantifying the thermal performance of passive solar heating systems. The three dimen-

sionless performance indicators which were previously introduced by the authors are further refined and tested. They are: the efficiency, a measure of the quality of the design; the effectiveness, a measure of the capacity of the passive system relative to the building load; and the comfort index, a means of judging potential discomfort due to indoor temperature fluctuations. Reasonable ranges are given for the many variables in order to facilitate system design. These include effective absorptance, overall building conductances, and thermal mass versus floor area. Explicit analytical solutions for three or four node models are effected which clearly reveal the performance characteristics of direct gain and storage-wall designs. Several performance bounds for passive solar systems are generated. The results provide a rational means of judging relative performance characteristics of architectural concepts and afford a quantitative design tool.

8988 **Designing passive solar buildings to reduce temperature swings.** Balcomb, J.D. (Los Alamos Scientific Lab., NM). pp 1545 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

8989 **Hybrid active-passive designs: synergy or conflict.** Balcomb, J.D.; Hedstrom, J.C.; McFarland, R.D. (Los Alamos Scientific Lab., NM). pp 1556-1560 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Hybrid combinations of active and passive solar heating systems are analyzed using hour-by-hour simulation analysis for a combined space heating and domestic hot water load in Albuquerque and Madison. Various mixes of passive and active solar collection are are studied. The passive system is a Trombe wall design and the active system uses liquid heating collectors.

8990 **Integrating energy approaches in a large office building.** Villecco, M. pp 1561-1564 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The TVA office complex for Chattanooga will be a demonstration of energy conscious design, pushing the state of the art in combining urban density with a solar envelope and in using daylight as a primary energy strategy. The quantitative and qualitative design objectives of the project, the interdisciplinary team approach, and the technical conclusions of the design team are described. Also, the impact of the project on Chattanooga in terms of solar zoning are discussed and efforts to use cogeneration with renewable resources to provide off-the-grid power are described.

8991 **Utilization of natural/passive energy systems in a University Office/Teaching Laboratory Building.** Martin, R.J. (Everett, Zeigel, Tumpes and Hand, Boulder, CO). pp 1565-1568 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The design of a University Office/Teaching Laboratory Building located on the Colorado Springs campus of the University of Colorado is described. The 52,300 gross square foot building houses 7225 ft^2 of chemistry laboratories, 7800 ft^2 of biology laboratories, 1750 ft^2 of research laboratories and 29,925 ft^2 of general classroom, office and building support spaces. In this building, the design team was able to minimize total energy consumption by the use of (1) nighttime cooled water used in conjunction with an evaporative cooling system to reduce total electrical demand, (2) prudent use of natural light to supplement artificial lighting requirements and early morning warm-up periods with southeast facing roof monitors, and (3) manipulation of cooling loads to replace heating loads by allowing the additional building mass to absorb heat during the day and flushing that heat out of the building at night when electrical demands are lowest. (WHK)

8992 **Economic aspects of passive solar remodeling in existing buildings.** Mickelson, J.L. Jr., Sizemore, M.M. (Sizemore/CRS, Atlanta, GA). pp 1569-1573 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Evans Junior High School, Spartanburg, South Carolina, stresses those passive solar and natural cooling characteristics that provide the greatest potential for reduced energy consumption. Evaluation of this school provides recommendations for recognizing and adapting to the thermal performance of existing buildings which are in the process of being recycled.

8993 **Combined microeconomic analysis of thermal storage roof passive solar heating and cooling.** Kirschner, K. (Univ. of New Mexico, Albuquerque); Ben-David, S.; Noll, S.A. pp 1574 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

8994 **Indigenous passive homes in Maine.** Johnston, D.R. (PRC Energy Analysis Co., McLean, VA). pp 1575-1577 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Down Easters have always been independent folks who place self-sufficiency high on their list of priorities. Maine, being at the end of the energy pipeline has generally high electricity and fuel costs, which provides further impetus for cutting the ties with the energy umbilical cord. The Shelter Institute in Bath, Maine was established in 1975 by Dr. Charles Wing to provide Mainers with the skills to design and build their own low-cost, passive solar homes. These homes are often autobiographical in their reflection of their owner's tastes and character, running the gamut from add-on greenhouses to hybrid passive designs. Interest in passive solar is growing at a rapid pace in Maine with more and more houses going up each year. Local builders, architects, bankers and real estate people have been inspired to learn more by attending special seminars at Cornerstones Institute which was started by the Wings in 1976 to provide specifically tailored information to diverse groups interested in passive solar. These seminars have closed the loop by bringing together the respective people necessary to design, finance, build and sell these houses in the area. The result has been over 500 of these homes being built with many more planned or underway.

8995 **Staff residences and support facilities, Ossabaw Island Wildlife Management Preserve, Ossabaw Island, Georgia.** Mickelson, J.L. Jr.; Sizemore, M.M. (Sizemore/CRS, Atlanta, GA). pp 1578-1582 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

This project includes the design of three staff residences and a maintenance facility for a wildlife management preserve on Ossabaw Island, off the coast of Savannah, Georgia. The structures were designed under contract in March, 1978 for the Department of Natural Resources, State of Georgia.

8996 **Preliminary winter comparison results of four passive test cells in Omaha, Nebraska.** Chen, B.; Maloney, J.; Thorp, J.; Pedersen, K.; Holmes, W.; Sedlacek, C.; Sash, R.; Hollingsworth, E. (Univ. of Nebraska, Omaha). pp 1583-1587 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Four test cells incorporating various passive solar energy techniques have undergone testing since the end of December 1978. The purpose of this research is to evaluate the suitability of passive solar energy to the midwestern winter climate and to compare the performance of the direct gain with the Trombe wall type of pas-

sive system. In order to accomplish these goals, the predicted computer performance studies performed by a Los Alamos Scientific Laboratories team which is headed by Dr. Douglas Balcomb are being corroborated by test cells which have been erected on the Omaha campus of the University of Nebraska at Omaha by the School of Engineering Technology of the College of Engineering and Technology.

8997 **Comparative impacts of six levels of energy-conserving (envelope) design and a seventh (high-mass, direct gain) passive option in parallel of a small second floor greenhouse for single family residence in a mild Mediterranean marine climate.** Schoen, R.; de Senepart, B.; Sircus, J. (Univ. of California, Los Angeles). pp 1588 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

8998 **Performance of passive test units during the 1978-79 heating season.** Wheeling, T.; Wadsworth, B.; Palmiter, L. (National Center for Appropriate Technology, Butte, Montana). pp 1589-1593 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Several passive solar test units have been monitored at the National Center for Appropriate Technology since January 1978. The design, instrumentation, and performance of the direct gain and Trombe wall cells, during the 1978-79 heating season, are discussed. A continuous sequence of hourly measurements, including incident radiation, air temperatures, and thermal storage temperatures has been recorded for the six month period, November 1978 through April 1979. These measurements have been used for the validation of a simple computer simulation model developed at NCAT.

8999 **Performance analysis of a natural convection collector system.** Cook, J. (Arizona State Univ., Tempe); Morris, S. pp 1594-1598 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A 100% passive heated solar house in the mountains of Arizona, utilizing a full-scale natural convection collector system with a rock bed storage, has been extensively monitored. An intensive examination of a one-day cycle, as well as a continuous six-day sequence, graphic analysis, plus numerical calculations and evaluation is presented. The results show efficiencies ranging between 30.5% and 443.3% during the demanding period of December 20 to 28. Documentation illustrates the parameters and advantages of such passive solar collector systems with isolated thermal storage. Recommendations and conclusions are made for final adjustments to this system and for the design of future convective systems.

9000 **Initial experimental tests and theoretical considerations in the use of small passive-solar test boxes to model the thermal performance of passively solar-heated building designs.** Grimmer, D.P. (Los Alamos Scientific Lab., NM) pp 1599 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

9001 **Measured performance of a passive solar residence in Bozeman, Montana.** Fowlkes, C.W. (Fowlkes Engineering, Bozeman, MT). pp 1600-1604 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The thermal performance of a passive solar house is summarized. Hourly data taken over a three month period during one of the coldest winters on record showed that the solar system was providing 65% of the heating load. The average house temperature was 19°C and the average daily variation was 6.4°C. A low-cost data acquisition system utilizing a Radio Shack TRS-80 computer was developed for this project.

9002 **New and simple method for estimating the monthly and yearly performance of passive solar systems.** Warrington, R.O.; Stotts, R.E.; Mussulman, R.L.; Martindale, W.R. (Montana State Univ., Bozeman). pp 1606-1609 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A sub-hourly simulation computer program that will model natural passive systems starting from basic principles has been developed and verified. Several design techniques and climatic design factors are investigated using the computer program. The model studies indicated that both the difference in day and night temperatures and the duration of consecutive sunny/cloudy days would affect any simplified passive design method. Using the conventional definition of Degree-Days the model under-predicted the performance of the passive solar system. By redefining Degree-Days the model was able to duplicate the base case which utilized sub-hourly ambient temperature variations. The way in which the cloudy/clear days were grouped had an even greater effect. At the present time this climatic factor is not being considered in any simplified active or passive design technique.

9003 **Procedure for determining solar heat gain factors for south-facing vertical surfaces on average days.** Powell, G.L.; Yellott, J.I. (Arizona State Univ., Tempe). pp 1615-1619 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

South-facing glazing is generally a significant feature of passive solar designs. A methodology which can be of considerable help in estimating the long term average performance of such designs is presented. A procedure has been devised to: (1) estimate the hourly irradiation incident upon south-facing vertical surfaces on average days, and (2) determine the amount of this irradiation that would be gained through a standard reference glazing. For efficient application of the model, a FORTRAN computer program has been written which requires as input only the latitude of the site and average monthly values of daily total horizontal irradiation. Comparison of results obtained with this model with ASHRAE clear day calculations suggests that simply modifying clear day values by percentage of possible sunshine will not yield accurate estimates of SHGF on average days. It is hoped that this procedure, which is apparently both easier and more accurate than existing techniques, constitutes a timely contribution to the field of passive solar design.

9004 **On the use of TEANET in passive building design.** Kohler, J.T.; Sullivan, P.W.; Michal, C.J.; Lewis, D.C. (Total Environmental Action, Inc., Harrisville, NH). pp 1625-1629 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The use of TEANET, a generalized seven node thermal network program for the TI-59 programmable calculator, is illustrated for the design of passive buildings. Two case studies are examined, thermal networks are shown, and results are presented and discussed.

9005 **Modeling thermal networks with PCAP.** Chen, B.; Maloney, J.; Thorp, J. (Univ. of Nebraska, Omaha). pp 1630-1633 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A serious concern facing research in the passive solar energy area is the need for a common standard for comparing results from different geographical locations. Of particular interest might be the development of computer simulation codes. The Princeton Circuit Analysis Program commonly referred to as PCAP is a widely distributed electrical engineering networks package which can be easily utilized without modification in the simulation of passive

solar energy thermal networks. Such a study has been performed at the University of Nebraska on a Trombe-Michel wall. The test cell, which has a floor dimension of 5' by 8' and is 10' tall, is based on the Los Alamos Scientific Laboratories prototype design. Because of its nearly universal distribution among institutions of higher learning (particularly those with electrical engineering curriculums), PCAP can be a quick and flexible tool to a newcomer in the field. PCAP can also be considered as a possible candidate for standardizing modeling procedures by the passive solar energy research community.

9006 **Computer simulation of heating and cooling of ventilation air for a passive solar house.** Cristy, G.A. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. pp 1634 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

9007 **Application of phase change materials in passive solar systems.** Faunce, S.; Sliwkowski, J.; Guceri, S. (Univ. of Delaware, Wilmington). pp 1637-1641 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The Institute of Energy Conversion of the University of Delaware has designed and constructed a modular, hybrid passive solar energy collection and storage unit called the Thermal Wall Panel. The Thermal Wall Panel uses the concept of energy storage in phase change materials. In the winter of 1977-78, and again in 1978-79, the Thermal Wall Panel was tested at Solar One, the Institute's solar house and laboratory. The key results and conclusions from this testing and analysis program are presented.

9008 **Analytical and economic evaluation of heat pipe augmented passive solar heating systems.** Corliss, J.M.; Stickford, G.H. (Battelle Memorial Inst., Columbus, OH). pp 1642-1646 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Heat pipes offer an excitingly new dimension to thermal control and design problems. Several unique characteristics of heat pipes make them ideally suited for applications involving passive solar heating systems. Among the more useful of these characteristics are (1) long distance, isothermal heat transport, (2) thermal diode behavior, and (3) passive operation. Analytic models have been formulated to predict the thermal performance of passive heating systems in a variety of climates. The systems that were simulated were of the Trombe mass wall type and included both conventional passive heating systems with moveable insulation systems and heat pipe augmented mass walls. Parametric analyses of several important design variables have shown areas of significant manufacturing cost savings with little sacrifice in thermal performance as measured in terms of solar fraction.

9009 **Dual desiccant-bed dehumidifier with solar-heated regeneration.** Moore, F.; Cantrell, J.; Willeke, G. (Miami Univ., Oxford, OH). pp 1647-1650 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The system utilizes low-cost desiccant materials for dehumidification, and solar heat for regeneration and convective air circulation. It consists of two identical adjacent arrays of desiccant, each alternately used for dehumidification or regeneration/convection. An apparatus model has been constructed and successfully tested to verify air flow. Several desiccant materials have been tested and evaluated for use in the system.

9010 **Optical and thermal properties of windows for passive solar systems.** Bruno, R.; Hoerster, H.; Koestlin, H.; Soellner, G.; Steinmueller, B. (Philips Research Labs., Aachen, Germany). pp 1651 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

9011 **Design and performance of low heat loss window systems.** Berlad, A.L.; Yeh, Y.J.; Tutu, N.; Jaung, R. (State Univ. of New York, Stony Brook). pp 1652-1655 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The window systems developed at State University of New York at Stony Brook use a variety of venetian blind-like interpane elements to correct the inability of ordinary twin-pane windows to profit from increased core thickness. Further, the reflective surfaces of the interpane blinds tend to suppress the unwanted infrared radiative transport, even when they are employed in the solar acceptance (open) mode. When the blind arrays are employed in the closed (nighttime or privary) mode, virtually complete infrared decoupling of the two panes is achieved. Heat transfer tests, interferometric studies, and seasonal performance are reported. (WHK)

9012 **Radiative cooling characteristics of surfaces exhibiting spectral and directional selectivity.** Landro, B.; McCormick, P.G. (Univ. of Western Australia, Nedlands). pp 1656-1659 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The radiative properties of the atmosphere are well known to be both spectrally and directionally dependent. In the 8 to 13 μm atmospheric transparency window the energy emitted by a clear sky is substantially less than the black body emission at ambient temperature, also the clear sky emission at low zenith angles is substantially less than at large angles. Radiative heat exchange between a clear sky and surfaces with radiative properties dependent on both wavelength and direction are studied. The effects of conductive heat loss and ambient temperature on the thermal exchange are also treated. Experimental measurements of net heat loss of surfaces exposed to clear skies as a function of radiator and ambient temperature have been carried out using both gray and spectrally selective surfaces. The experimental results are in good agreement with the theoretical analysis.

9013 **Solar-cladding: insulation plus insolation.** MacGregor, A.W.K. (Napier College, Edinburgh, Scotland). pp 1665-1668 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

This is an investigation into the possibilities of applying translucent insulation material to the outside surface of existing solid walled buildings, so that the basic heat loss is reduced and, unlike conventional opaque insulation, the solar gain through the wall is increased. Theoretical analysis and experimental work both indicate that the potential energy savings per unit area are of the same order as for solar water heating systems - but with costs at least an order of magnitude less. The main area of application is likely to be in high latitude, maritime regions where overheating is not a problem.

9014 **Hybrid passive for motel guest rooms.** Wright, R.; Dieckmann, L.; Selby, R.; Wright, S. (Hawkweed Group, Ltd., Chicago, IL). pp 1669-1673 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A 19,000 square foot solar-heated motel at Osseo, Wisconsin, contains twenty guest rooms, three shops, banquet facilities, restaurant and lobby. An appropriate integral system was selected for

each area of the building based upon occupancy profile. Systems used include mass walls at guest rooms, direct gain at shops and site-built flat plate air type collectors at public spaces. The various systems, the design process, and construction methods are described.

9015 **Magnificant entrance: the Energy Wing.** Steel, G.B. pp 1674-1678 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The home of Bill and Linda Conner in Ramona, California (Latitude 33°N) is presented as an example of a passive solar home using an Energy Wing entrance. The Energy Wing is designed to collect enough solar energy to heat the whole house during the winter and also to use night ventilation during the summer to cool the house. Construction costs and specifications for the Conner house are presented and preliminary performance data are described. Also the Thermafloor, thermal floor system, is introduced. This is a concrete floor system, that stays warm in the winter and cool in the summer. Photographs are presented showing the Energy Wing and its thermal mass along with exterior and interior details of the Conner home.

9016 **Sun-bin passive solar concept.** Bourne, R.C. pp 1680 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

9017 **Passively solar heated and cooled residence in Iowa City, Iowa.** Schoenfelder, J.L. (Central States Energy Research Corp., Iowa City, IA). pp 1681 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

9018 **Retrofit sun room thermal performance based on the typical meteorological year weather data.** Wessling, F.C.; Harley, E.L.; Roache, P.J.; Marrable, W.C.; Litz, B.C. (Univ. of New Mexico, Albuquerque). pp 1684-1688 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A thermal network simulation model of a sun room forms the basis of a computer simulation of the sun room attached to a dwelling. Results of the simulation predict average thermal performance of sun rooms attached to identical buildings in eight different locations with latitudes varying from 32°N to 47°N and with Fahrenheit heating degree days varying from 1970 to 9033. Efficiencies varied from 5.8% to 37% depending on location. From this information a builder may decide whether a sun room is applicable in his locale.

9019 **Design and initial performance of the solarium-assisted dormitory at the White Mountain School, Littleton, NH.** Converse, A.O. (Dartmouth College, Hanover, NH); Hall-Martindale, M.; White, C.S. Contract EG-77-6-04-4139. pp 1689-1693 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A building with a hybrid solarium-based heating system is described, including costs for the solar components. The mini-computer monitoring system is described, and preliminary monitoring results are presented and compared to design expectation. The response of occupants is also discussed.

9020 **Construction and performance of greenhouse-residence prototypes SGR-2 and SGR-4.** Zornig, H.F.; Godbey, L.C. (Science and Education Administration, Clemson, SC). pp 1694-1698 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A solar heated greenhouse and residence have been completed for energy conservation, efficient utilization of solar energy and family food production. Construction experience and operation of two prototypes show a need for the development of improved construction details, improved system operation, and improved horticultural practices.

9021 **Commercial growers passive solar greenhouse at the Hidden Springs Nursery, Cookeville, Tennessee.** McGowan, T.F. (Georgia Inst. of Technology, Atlanta). pp 1704-1707 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A large scale passive solar greenhouse in Tennessee has operated successfully for two winters. The greenhouse design incorporates passive heat storage and natural ventilation for year-round use. The design methodology, construction details, and the results of the first winter's operation are presented.

9022 **Design, experimental results and socio-economic impact of a northern climate commercial greenhouse.** Maes, R.; McKenney, H.; Riseng, C. (Environmental Research Inst. of Michigan, Ann Arbor). pp 1708-1712 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Fifteen percent of the energy in the United States is used in the total food system and approximately one-fifth of this is in the vegetable and produce sector. High grade energy is used to produce, process, package and transport food that could be locally grown by using low grade solar energy in specialized greenhouses. The national budget demonstrates that Federal efforts to develop this low energy technology have been minimal. Design and operational data are presented for a commercial sized northern climate greenhouse that requires one-sixth of the normal energy requirements. A brief review is given of protected cultivation in other countries, also other applications for the pivoted-reflector-insulator are mentioned.

9023 **Investigations with a heat storage-night cover Brace design greenhouse for colder regions.** Lawand, T.A.; LeNormand, J.; Skelton, A.; Dorgan, M.; MacArthur, J. pp 1713 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

9024 **Culturally relevant approach to the appropriate utilization of solar energy in low-cost housing.** Bentley, D.; Felder, A.; Perez, D.; Pommier, P. (Passive Solar Designs, Austin, TX). pp 1714-1718 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A common misconception in the application of solar energy in building design is that it has to cost more than buildings incorporating only conventional energy sources. For the majority of solar installations to date using mechanical or active collection systems, this has been the case. But there now exists another type of solar utilization system for which this is not necessarily true. Instead of using elaborate mechanical equipment to collect solar energy, passive solar systems use the fabric of the building itself. South facing glazing becomes collector aperture. Concrete slabs and masonry walls become thermal storage. Distribution is accomplished by the natural modes of radiation and natural convection. Since the building materials themselves are employed, no additional expense for solar equipment is necessary. Through the use of inexpensive materials and appropriate technologies truely low cost solar housing can be made a reality. Examples of passive solar heating systems in low-cost housing projects in Texas are given. (WHK)

1410 Solar Collectors And Concentrators

9025 (CONF-800995—, pp 147-152) **Solar ponds: power from the Great Salt Lake.** Boehm, R.F.; Newell, T.A. (Univ. of Utah, Salt Lake City). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The concept of a salt-stratified pond is outlined along with the history of its application. Characteristics of the Great Salt Lake pertinent to this concept are described. Research being pursued in the laboratory relative to solar ponds is reviewed.

9026 (CONF-800995—, pp 217-221) **Non-convecting solar ponds.** Ochs, T.L. (Desert Research Inst., Boulder City, NV). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

A unique class of integrated solar collector/storage concepts are described. A variety of non-convecting solar ponds are surveyed and ranges, performance, and costs are discussed.

9027 **(DOE/CS/33713—T1) Improvement of solar air collectors: Study and Experimental Research Project. Final report, May 1976-June 1978.** Cole-Appel, B.E.; Loef, G.O.G.; Shaw, L.E.; Fischer, B.B. (Solaron Corp., Denver, CO (USA)). 1978. Contract AC04-77CS33713. 209p. NTIS, PC A10/MF A01.

Literature and patents relevant to solar air-heating collectors were reviewed. The design constraints are listed. The analysis considered the heat transfer and pressure loss characteristics of the various designs. Three absorbers along with the baseline design were mounted in identical collector bodies and subjected to thermal efficiency tests on Solaron's collector test stand. The testing was done simultaneously on the four panels in a side-by-side collector test. Various manufacturing techniques for producing an absorber with extended heat transfer surface were investigated. It was found that fins could be attached to the absorber in a cost-effective manner by an electrical resistance weld. Four finned absorbers were fabricated by resistance welding and installed in a 2 x 2 collector array to verify that these production model prototypes would, in fact, increase performance by a factor of 1.11. (MHR)

9028 **(DOE/CS/34163—T1) Image collapsing concentrators. Final technical report, 1 October 1977-1 October 1980.** Sletten, C.J.; Herskovitz, S.B.; Holt, F.S.; Stiglitz, M.R. (Solar Energy Technology, Inc., Bedford, MA (USA)). 22 Sep 1980. Contract FG04-77CS34163. 45p. NTIS, PC A03/MF A01.

Wide-angle focusing Fresnel Lenses with specially curved image collapsing mirrors are developed for nontracking solar concentrators. A new type of stepped prism lens is designed with prism facets on either the inside or outer lens surface which concentrates solar radiation incident in a 60° elevation by 100° azimuth angle sectors. Thermal tests on a small model collector with a dielectric lens aperture 30 1/2 x 30 1/2 cms were conducted using a single subreflector which concentrated all acceptance zone radiation onto a fixed absorber shelf 8 cms wide. With absorbing copper tubes coated with black chrome carrying water as circulant thermal efficiencies of approximately 50% on large East West deployed solar panels are estimated. Vacuum abosrbers were also installed with improved efficiencies and operating temperatures. Segmented subreflectors were designed to increase concentration ratios from 3 to approximately 12. An economic study of the comparative cost vs performance advantages of this new technology was made. Production cost (1980) for the stepped lens - single subreflector concentrator were estimated at about $113. per meter^2 ($10.50 per ft^2). Because of the wider angular coverages, thinner structures, and sharp focusing available for larger concentration ratios, the new technology offers important advantages at lower costs over other concentrating nontracking solar collectors. A thin collector panel was studied which uses a novel internal absorber rod lens and the high thermal conductivity of copper strups for heat extraction. Thermal efficiencies and concentration ratios of about 3 are projected with important savings in collector materials.

9029 **(SAND—78-8193) Heliostat materials development and evaluation. Final technical report, February 5, 1979-June 30, 1980.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 1980. Contract AC04-76DP00789. 110p. NTIS, PC A06/MF A01.

The objective of this program was to produce, characterize, and test enclosure and reflector materials with the purpose of establishing a firm data base for the prediction of useful life cycles and of upgrading the performance of enclosed heliostat systems, leading to a lower cost/performance ratio. The films selected for testing as potential enclosure materials were uv-stabilized poly(ethylene terephthalate) (PET) and poly(vinylidene fluoride) (PVDF). The stabilized polyester film appeared to be a likely candidate considering its cost, optical and mechanical properties, and its apparent weatherability (based on uncontrolled testing). Biaxially-oriented PVDF was selected as a candidate because, although not yet in commercial production, it appeared to have tensile strength approaching that of PET, extremely high clarity, and presumably good weathering resistance. While there is a great deal of data on the weatherability of PVDF in the form of protective coatings or of protective or decorative appliques, no data were available concerning the weathering properties of unsupported, biaxially-oriented film. A number of second-surface reflectors were investigated, and a laminated aluminized PET reflector available from Martin Processing Co. was selected for testing. First-surface aluminized PET, both unprotected and protected by a thin layer of DOW Corning Q96315 resin, also were selected for testing. Procedures and results of weathering tests are detailed. Also methods for bonding plastic films, specularly-optimized film reflectors, and the mechanism of weathering degradation are discussed. Data on the flammability of plastic films are included. (WHK)

9030 **(SAND—80-0702) Development of sheet molding compound solar collectors with molded-in silvered glass reflective surfaces.** Champion, R.L.; Allred, R.E. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1980. Contract AC04-76DP00789. 41p. NTIS, PC A03/MF A01.

The reflecting concentrator of a parabolic trough solar collector system comprises approximately 40% of initial system cost. The parabolic concentrator structure is also the most influential component in determining overall system efficiency. Parabolic test moldings have been fabricated from a general purpose sheet molding compound with flat chemically strengthened glass, flat annealed glass, and thermally formed glass. The test panel configuration was a 1.22 m x 0.61 m, 45° rim angle (0.762 m focal length) parabola. Attempts to mold with annealed sheet glass (1 mm thick) and thermally formed glass (1.25 mm thick) were unsuccessful; only the chemically strengthened glass (1.25 mm thick) was strong enough to survive molding pressures. Because of the mismatch in thermal expansion between glass and sheet molding compound, the as-molded panels contained a sizeable residual stress. The results are given of dimensional changes taking place in the panels under accelerated thermal cycling and outdoor aging conditions; these results are compared to an analytical model of the laminate. In addition, the sheet molding compound has been examined for thermomechanical properties and flow behavior in the rib sections. Results indicated that lowering the thermal expansion coefficient of the sheet molding compound through material modifications would produce a more stable structure.

9031 **(SAND—80-1964/1) Midtemperature Solar Systems Test Facility predictions for thermal performance of the Solar Kinetics T-700 solar collector with FEK 244 reflector surface.** Harrison, T.D. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 23p. NTIS, PC A02/MF A01.

Thermal performance predictions are presented for the Solar Kinetics T-700 solar collector, with FEK 244 reflector surface, for three output temperatures at five cities in the United States.

9032 **(SAND—80-1964/2) Midtemperature Solar Systems Test Facility predictions for thermal performance of the Suntec solar collector with heat-formed glass reflector surface.** Harrison, T.D. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 22p. NTIS, PC A02/MF A01.

Thermal performance predictions are presented for the Suntec solar collector, with heat-formed glass reflector surface, for three output temperatures at five cities in the United States.

9033 **(UCLA-ENG—8039) Transparent glass honeycomb structures for energy loss control. Final summary report, January 1976-October 1979.** (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Jun 1980. Contract FG03-76CS31084. 106p. NTIS, PC A06/MF A01.

It has been demonstrated that properly-shaped glass honeycomb placed between a non-selective absorber and the coverglass of a flat plate solar collector gives collection efficiencies significantly higher than those of conventional flat plate units, even those with selective absorbers, collecting solar energy at temperatures required for heating and cooling buildings. Three basic glass honeycomb shapes were analyzed and tested: (1) thin-walled cylindrical glass tube honeycomb in square or hexagonal arrays, (2) corrugated thin glass sheets stacked peak-to-trough to form double-sinusoid-shaped cells, and (3) flat thin glass sheets stacked to form long parallel slots. A continuous hot-rolling mill was used to corrugate commercial Micro-Sheet glass, thus demonstrating a key step needed for the commercialization of glass honeycomb fabrication. Experimental-scale (61 cm x 61 cm) collectors and collectors scaled-up in area were fabricated and tested outdoors to verify the analytical-numerical performance-prediction algorithms developed during the program. Optimization studies were made with respect to performance and cost to identify optimal shapes of sinusoidal-celled glass honeycombs which have high potential for mass production.

9034 **Control of gradient zone boundaries.** Neilsen, C.E. (Ohio State Univ., Columbus). pp 1010-1014 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The collection and storage efficiency of salinity gradient solar ponds depends strongly upon the thickness of the surface convective zone and of the nonconvective gradient zone. It is known that the equilibrium position of a gradient zone boundary varies with the salinity and temperature gradients at the zone boundary. A continuous liquid injection procedure that modifies the salinity profile and changes the salinity gradient at zone boundaries is described. The positions of boundaries are thus controllable so as to keep the surface zone thin and to optimize the gradient zone. The equipment required is simple and low cost; the modification of the gradient is well defined and predictable.

9035 **Large size solar ponds for electricity production.** Assaf, G.; Doron, B.; Weinberger, Z.; Vroebel, E.; Hershman, H.; Katz, A.; Sarig, S. pp 1020 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

9036 **Physics of a saturated $Na_2O.2B_2O_3.10H_2O$ nonconvecting solar pond.** Ochs, T.L.; Bradley, J.O. (Univ. of Nevada System, Boulder City). pp 1026-1028 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Simple analytical techniques have been devised to test salts for suitability in a saturated solar pond. Use of one of these suitable salts in an experimental pond at Desert Research Institute has resulted in successful operation of a saturated pond. Low ion mobility dictates that a real saturated solar pond will operate at significantly less than saturation which means need for less solute.

9037 **Cost and value of washing heliostats.** Eason, E.D. (Sandia Labs., Livermore, CA). Contract AC04-76DP00789. pp 1177-1180 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

An equation is derived for the washing frequency that minimizes cost per unit energy for solar collectors of any type. Central receiver heliostats of two designs are used in an example, and the results for Albuquerque soiling rates show that washing 15 to 30 times per year is worthwhile. The optimal frequency is directly or inversely proportional to the square root of the relevant parameters, but it is not sensitive to number of collectors or plant size. The frequency for minimum cost per unit energy corresponds to the strategy of washing whenever the value of the extra energy from cleaner mirrors will pay for the cost of the wash.

9038 **Collector comparison based on year round average performance.** Collares-Pereira, M. (Univ. of Chicago, IL); Rabl, A. Contract ER-78-S-02-4657. pp 1194 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

9039 **Performance analysis for collector-side reflector systems.** Espy, P.N. (NASA/MSFC, Huntsville, AL). pp 1208-1212 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Solar collector arrays employing flat-plate collectors and planar side reflectors have been tested by several groups. The instantaneous performance of these arrays has been analyzed from multiple approaches. Testing and analysis have consistently shown remarkable increases in energy collection above that for collectors without augmenting reflectors. However, long-term system performance has not been analyzed. The analytical work of Beckman, Klein and Duffie in solar energy systems for heating and/or hot water application has produced a standard methodology for system performance evaluation. The F-Chart method of their devising can handle a variety of system types employed over a wide range of meteorological conditions. The solar collector type assumed for these analyses was a flat-plate collector. The method by which the F-Chart method may be modified to provide long-term performance predictions for a side reflector augmented flat-plate collector system is detailed.

9040 **Thermic diode performance characteristics and design manual.** Bernard, D.E. (Jet Propulsion Lab., Pasadena, CA); Buckley, S. Contract EG-77-S-02-4383. pp 1218-1222 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Thermic diode solar panels are a passive method of space and hot water heating using the thermosyphon principle. Simplified methods of sizing and performing economic analyses of solar heating systems had until now been limited to passive systems. A mathematical model of the thermic diode including its high level of stratification has been constructed allowing its performance characteristics to be studied. Further analysis resulted in a thermic diode design manual based on the f-chart method.

9041 **Numerical approach to the flux density integral for reflected sunlight.** Lipps, F.W. (Univ. of Houston, TX). Contract EG-77-C-04-3974. pp 1266-1270 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A computer model of the central receiver system must evaluate the flux density on the receiver due to sunlight reflected by the heliostats in the collector field. The new approach proposed assumes isotropic Gaussian guidance errors. Hence, the flux density integral reduces to several iterated single integrals which can be precalculated and stored in a table for interpolation as needed. The LBL solar telescope data are fed into a convolution integral which represents the guidance errors. Aureole effects can be switched on or off at this point. A vector of convoluted solar data is input to another integration which gives the table of normalized flux contributions. The tabular values depend on the position of the flux point

with respect to an edge of the heliostat as seen in the image plane. The image map of the heliostat is linear unless ripples or irregularities occur; hence, effects due to canting and dishing are included by a ray trace of the heliostat vertices. The use of tabular interpolation is not as fast as expected because of the time required to calculate the distance between the flux point and the image of the vertices. The accuracy of this method is limited by interpolation errors, and better results can be obtained with the same CPU time if more core is used for a larger table. The convolution process in KGEN is fast and can be used to calculate moments for HCOEF and coefficients for FLASH which utilize the LBL data.

9042 **Analytical and experimental determination of radiation and temperature distributions inside solar receivers.** Blay, D.; Haziza, C. (Centre National de la Recherche Scientifique, Poitiers, France). pp 1276-1280 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A cooled cubic cavity receiving a non uniform concentrated solar radiation is modelized, using the diffuse and semi-gray surface hypothesis and the net radiation method equations. Two more equations corresponding to the heat transfer to a cooling fluid permit to define a heat balance. Thus at thermal equilibrium, net fluxes and temperatures inside the cavity are calculated. An air-cooled solar receiver has been set up at a 6 kW solar furnace. Flux and temperature measurements have been performed for different coatings of the inside surface. Theoretical and experimental results are then compared and discussed.

9043 **Unfolding concentrator slope errors from reflected-beam measurements.** Biggs, F.; Vittitoe, C.H.; King. D.L. (Sandia Labs., Albuquerque, NM). Contract AC04-76DP00789. pp 1286-1288 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A measured flux-density pattern in the reflected beam of a heliostat is analyzed to unfold the distribution of surface slope errors for a heliostat reflecting surface. It is found that two-dimensional effects in this error distribution are within the resolution of the measurement.

9044 **Thin glass reflector laminate for solar concentrators: design, fabrication and testing.** Marion, R.H.; Reuter, R.C. Jr. (Sandia Labs., Albuquerque, NM). Contract AC04-DP00789. pp 1294 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

9045 **Design and performance characteristics of compound parabolic concentrators with evacuated and with non-evacuated receivers.** Collares-Pereira, M. (Univ. of Chicago, IL); O'Gallagher, J.; Rabl, A.; Winston, R.; Cole, R.; McIntire, W.; Reed, K.; Schertz, W. Contract EY-76-S-02-2446;W-31-109-ENG-38. pp 1294-1299 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Compound Parabolic Concentrators permit the use of low to moderate levels of concentration for solar thermal collectors without the requirement of diurnal tracking. When used in conjunction with evacuated absorbers with selective surfaces a fully stationary CPC (designs with concentrations 1.1X - 1.4X are now commercially available) has a typical efficiency of about 40% at 150°C (270°F) above ambient with available conventional materials. An experimental higher concentration 5X CPC requiring approximately 12 tilt adjustments annually, when used with a similar available evacuated absorber has been built having a measured efficiency of 60% at 220°C above ambient and is capable of efficiencies near 50% at 300°C. With such thermally efficient absorbers higher concentrations are not necessary or desirable. The temperature capabilities for CPC's with non-evacuated absorbers are somewhat more limited. However, with proper design, taking care to reduce parasitic thermal losses through the reflectors, non-evacuated CPC's will outperform the best available flat plate collectors at temperatures above about 50°C to 70°C.

9046 **Process steam generation by a facetted, non-imaging solar concentrator.** Ortabasi, U. (Center for Energy and Environment Research, Mayaguez, Puerto Rico); Atienza, J.A.; Soderstrom, K.G.; Lopez, A.M.; Ozakcay, L.M.; Winston, R. pp 1300-1303 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A modular non-imaging trough collector for the generation of process steam in a tropical environment has been designed and built. The concentrator design has the desirable features of low cost and light weight. Transportation and installation costs are reduced by its modular aspect. The most innovative feature of this concentrator is that the mirror surface consists of long and narrow planar facets sealed inside low cost glass tubes. The absorber for this collector is also a new design.

9047 **Computational alignment method for paraboloidal collectors.** Edwards, B. (Australian National Univ., Canberra). pp 1309-1313 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

An alignment method for collectors is described which has the potential for lowering installation costs. Alignment may be regarded as the process which relates the position of the actuators on the collector to the corresponding pointing direction of the collector. Traditionally, open loop pointing systems operate using equatorial or altitude-azimuth mounts where the axes and the zero points of the position encoders are adjusted to coincide with the conventions for the mount chosen. Such a process is time consuming and costly, particularly if the process needs to be repeated. The method described here needs no manual intervention, requires no adjustments, and can be used on any type of mount. Costs are estimated at around $0.10 per alignment. The process involves gathering a set of pointing directions and the corresonding set of actuator positions, as recorded by the position encoders. The process is detailed mathematically and the required analysis outlined. The accuracy of the alignment is given as a function of the system variables.

9048 **Computer control in sun tracking mechanism for solar thermal system.** Yamada, T. (Government Industrial Research Inst., Nagoya, Japan); Noguchi, T.; Tsukada, K. pp 1314 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

9049 **Identification of alignment and tracking errors in the open loop, time based heliostat system of the 400 kW Advanced Components Test Facility.** Teague, H.L.; Brown, C.T.; Swafford, C.J.; Lewis, G.C. (Georgia Inst. of Technology, Atlanta). pp 1315-1318 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The Advanced Components Test Facility (ACTF) is operated by the Georgia Institute of Technology, Engineering Experiment Station for the United States Department of Energy. This facility includes a heliostat field employing a unique tracking system which is mechanically driven without feedback. The sources of alignment and tracking errors for this system are, therefore, different from those found in closed-loop tracking systems as well as computer controlled open-loop systems. Initial operation of the ACTF in 1977 and 1978 indicated that several subtle sources of alignment tracking error existed and required corrective action. A review of these tracking errors and their effects has recently been completed. Based on the initial analysis of the mirror field tracking performance, changes in alignment hardware and procedures have been implemented and the effects of these improvements have been

measured. The original tracking system hardware, installation procedures and alignment methods are described. The sources of tracking errors are discussed and modifications necessary to minimize their effects are described.

9050 **Collector deflections due to wind gusts and control scheme designs.** Edwards, B. (Australian National Univ., Canberra). pp 1319-1323 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The relationship between the spectrum of collector deflections due to winds and the composition of the guidance scheme controlling the collector is considered. The interface between these two factors is the required rigidity of the collector because rigidity is dependent on both factors. As rigidity is an expensive commodity, it is important that the collector is not under or over-designed in this respect. The average sun following error is presented as a function of collector rigidity and guidance and control scheme type. Inverse data, namely the required collector rigidity as a function of average sun following error and guidance and control scheme type, is also presented. This shows that guidance and control schemes which have bandwidths encompassing the spectrum of wind gusts and include wind effects as inputs in the servo loop give an advantage in cost due to lower structural rigidity requirements. There is little difficulty in designing a guidance and control scheme which will meet both of these requirements. This discussion applies to both direct tracking collectors and heliostats.

9051 **Simple technique for measuring slope or surface error of a concentrator.** Sanchez, J.; Saylor, W. (General Electric Valley Forge Space Division, PA). pp 1324-1327 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

With growing attention being given to point- and line-focusing solar concentrating systems, it has become increasingly important to be able to characterize a reflector component's optical quality. This is determined not only by the total hemispherical reflectance of the surface, but also by the microscopic and macroscopic imperfections of the surface. These defects can cause incident solar radiation to be reflected outside the relatively small receiver target area. Specularity deals with microscopic surface characteristics. Macroscopic or structural malformations fall under the heading of slope errors, and a technique for their measurement is discussed.

9052 **How to measure the optical quality of focusing solar collectors without laser ray tracing.** Bendt, P.; Gaul, H.; Rabl, A. (Solar Energy Research Inst., Golden, CO). pp 1328-1332 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Designers and manufacturers need a tool for evaluating the optical quality of solar concentrators. In addition to the optical efficiency eta/sub o/, it is important to have a measure of optical errors and of losses due to reflected radiation missing the receiver. A novel alternative to the laser ray trace technique is described. The new method does not require any equipment beyond what is used for measuring collector efficiency; it could therefore become part of routine collector testing. The total optical errors resulting from imperfect specularity and from inaccuracies in reflector position or slope are characterized by an angular standard deviation sigma/sub optical/, the rms deviation of the reflected rays from the design direction. The method is based on the fact that the off-axis performance of a concentrator depends on sigma/sub optical/. An angular scan is performed; i.e., the collector output is measured as a function of misalignment angle over the entire range of angles for which there is measurable output (typically a few degrees). This test should be carried out on a very clear day, with receiver close to ambient temperature (if the latter condition cannot be satisfied, appropriate corrections are necessary). The parameter sigma/sub optical/ is then determined by a least squares fit between the measured and the calculated angular scan. The method was tested on a parabolic trough collector manufactured by Hexcel but it is suitable for parabolic dishes as well. The method appears to be accurate enough to determine sigma/sub optical/ within about 10%.

9053 **Effect of circumsolar radiation on performance of focusing collectors.** Bendt, P.; Rabl, A. (Solar Energy Research Inst., Golden, CO). pp 1338 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

9054 **Environmental influence on CRTF heliostat reflectance.** King, D.L.; Myers, J.E. (Sandia Labs., Albuquerque, NM). pp 1339 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

1420 Heat Storage

REFER ALSO TO CITATION(S) 8885, 8926, 9007, 9034

9055 **(CONF-7805216—) Storage in solar energy systems.** (International Solar Energy Society, London (UK). UK Section). 1978. 77p. NTIS (US Sales Only), PC A05/MF A01.

From Conference on storage in solar energy systems; London, UK (5 May 1978).

Separate abstracts were prepared for the seven included papers. (MHR)

9056 (CONF-7805216—, pp 11-30) **Studies of natural convection effects in an annulus containing a phase change material.** Marshall, R. (University Coll., Cardiff, England). 1978.

From Conference on storage in solar energy systems; London, UK (5 May 1978).

The experimental work to date performed to determine the inside heat transfer coefficient, the characteristic annulus spacing and the circumstances for which natural convection can be used to enhance the inherent low thermal conductivity of a paraffin wax are described. The results showed that average inside heat transfer coefficients in the range 10 to 20 W/m² °C can be expected. This means that the time to melt a sector undergoing natural convection is one to two orders of magnitude less when the sector axis is at the vertical and near vertical positions than the time required by conduction alone. Recommendations are given for geometries which lead to maximum or near maximum enhancement of melting by natural convection.

9057 (CONF-7805216—, pp 31-43) **Review of solar ponds.** Colbeck, I. (Clarendon Lab., Oxford, England). 1978.

From Conference on storage in solar energy systems; London, UK (5 May 1978).

The following topics are discussed relative to solar ponds: filling and stability, operating problems, operating ponds, calculated temperature response, and uses. The feasibility of solar ponds in the United Kingdom is discussed briefly. (MHR)

9058 (CONF-7805216—, pp 44-54) **Analytical and experimental study of the temperature distribution in a solar energy storage system.** Hawlader, M.N.A. (University Coll., Cardiff, England). 1978.

From Conference on storage in solar energy systems; London, UK (5 May 1978).

An analytical model is developed representing a generalized sensible heat store with direct solar energy input and fluid circulation from collectors. Predicted temperature distributions are presented for situations representing the operation of closed stores, swimming pools and solar ponds. A laboratory test rig is described, which has been used to simulate the situations modelled analytically. Agreement has been obtained between the analytical and experimental temperature distributions which is sufficiently good to justify the use of the store model in further studies.

9059 (CONF-7805216—, pp 55-58) **Chemical heat pumping and energy storage.** Smith, P.F. (Rutherford Lab., Chilton, England). 1978.

From Conference on storage in solar energy systems; London, UK (5 May 1978).

Studies are being made of the use of chemical systems: (1) to provide economic energy storage for various alternative or conventional energy sources, and (2) to convert low grade ambient or waste heat to a temperature suitable for domestic and industrial heating applications. Both of these objectives can be achieved by means of the two-vessel absorption heat pump. A concentrated solution in vessel 2 absorbed vapor from the pure solvent in vessel 1, cooling the latter and releasing energy at a higher temperature in vessel 2. This provides the heat pumping effect. For energy storage, the diluted solution is transferred to a storage vessel where it can be subsequently reconcentrated using intermittent energy sources. Possible applications and some suitable chemical systems are briefly discussed. (WHK)

9060 **(DOE/ET/20417—4) Thermal stability tests of heat transfer fluids for transfer and storage of thermal energy.** Schneider, G.R.; Morgan, G.R. (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.; McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Dec 1980. Contract AC03-76ET20417. 142p. (MDC-G—9331). NTIS, PC A07/MF A01.

Laboratory tests were conducted to evaluate the high temperature (288 to 343°C (550 to 650°F)) thermal stability, material compatibility, and surface fouling of selected commercial heat transfer fluids for a sensible heat thermal energy storage system to be used with a solar thermal electrical power generation plant. The tests have provided information on the rate of fluid replenishment required, the change of viscosity, the composition of lost products, and the rate of fouling of heat transfer surfaces as a function of temperature and time. Determinations have been made of the effect of the presence of materials likely to be used in the energy storage subsystem, (rocks, stainless steel, and carbon steel) on these properties.

9061 **Solar energy storage using reversible hydration/dehydration of $CaO/Ca(OH)_2$ applied to a commercial solar power station.** Rosemary, J.K.; Springer, T.H. (Rockwell International, Canoga Park, CA). pp 1186 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

9062 **Physical and chemical properties of phase change materials for application in solar tower and solar farm plants.** Heine, D.; Heess, F.; Groll, M. (Universitat Stuttgart, Germany). pp 1187-1191 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Experimental investigations have been carried out of the long-term behavior of latent heat storage materials for use in the temperature ranges 200 to 450°C and 700 to 900°C. These investigations comprise the corrosion of structural materials together with promising storage materials and the thermal stability of these storage materials. From the corrosion tests the mass losses of sheet metal samples have been measured and thickness reduction and corrosion rate have been calculated. Furthermore the corrosion type has been determined by optical and scanning electron microscopes. During cyclic tests, melting and freezing curves have been continually measured; thereby the thermal stability of the storage materials as a function of thermal cycling and repeated melting and freezing is determined. $NiCu_3OFE$ in combination with $KCl\text{-}ZnCl_2$ as well as mild steel (St35) and boiler steel (13CrMo44) in combination with $NaNo_3$ turned out to be corrosion resistant combinations for the temperature range 200 to 450°C. The structural materials for the temperature range 700 to 900°C (heat resisting steel and nickel alloys in combination with $MgCl_2$, NaCl and KF) showed a small corrosion rate; however, they revealed corrosion zones at the surface. which make their application problematic.

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

9063 **(DOE/ET/28476—T11) Oregon: a guide to geothermal energy development.** Justus, D.; Basescu, N.; Bloomquist, R.G.; Higbee, C.; Simpson, S. (Oregon Inst. of Tech., Klamath Falls (USA). Geo-Heat Utilization Center). Jun 1980. Contract AS06-77ET28476. 121p. NTIS, PC A06/MF A01.

Oregon's geothermal potential, exploration, drilling, utilization, legal and institutional setting are covered. Economic factors of direct use projects are discussed. (MHR)

9064 **(DOE/ET/28476—T12) Alaska: a guide to geothermal energy development.** Basescu, N.; Bloomquist, R.G.; Higbee, C.; Justus, D.; Simpson, S. (Oregon Inst. of Tech., Klamath Falls (USA). Geo-Heat Utilization Center). Jun 1980. Contract AS06-77ET28476. 117p. NTIS, PC A06/MF A01.

Alaska's geothermal potential, exploration, drilling, utilization, and legal and institutional setting are covered. Economic factors of direct use projects are discussed. (MHR)

9065 **(DOE/ID/12013—3) Wyoming Geothermal Commercialization Program; area development plans: Fremont County, Big Horn Basin, Converse and Natrona Counties, Wyoming.** (Wyoming Geothermal Commercialization Office, Laramie (USA)). Jul 1980. Contract FC07-79ID12013. 120p. NTIS, PC A06/MF A01.

Three papers are included. A separate abstract was prepared for each one. (MHR)

9066 (DOE/ID/12013—3, pp 27p, Paper 1) **Fremont County, Wyoming area development plan.** Marcotte, K. Jul 1980.

In Wyoming Geothermal Commercialization Program; area development plan: Fremont County, Big Horn Basin, Converse and Natrona Counties, Wyoming.

An overall view is presented of the potential for geothermal development in Fremont County, Wyoming. The prerequisites to geothermal development are considered and the development potential of that region for the next forty years is discussed. The following are described: historical and existing land use, resource areas, population trends, energy consumption, and site data summaries. (MHR)

9067 (DOE/ID/12013—3, pp 53p, Paper 2) **Big Horn Basin, Wyoming area development plan.** Caplan, J.; Marcotte, K. Jul 1980.

In Wyoming Geothermal Commercialization Program; area development plan: Fremont County, Big Horn Basin, Converse and Natrona Counties, Wyoming.

An overall view is presented of the potential for geothermal development in the Big Horn Basin, Wyoming. The prerequisites to geothermal development are considered and the development potential of that region for the next forty years is discussed. The following are described: historical and existing land use, resource areas, population trends, employment and energy consumption, proposed applications of the geothermal resource, an economic analysis of the proposed district heating systems, and site data summaries. (MHR)

9068 (DOE/ID/12013—3, pp 40p, Paper 3) **Converse and Natrona Counties, Wyoming area development plan.** MacDonald, J.; Marcotte, K. Jul 1980.

In Wyoming Geothermal Commercialization Program; area development plan: Fremont County, Big Horn Basin, Converse and Natrona Counties, Wyoming.

Potential geothermal sites are inventoried and the feasibility of geothermal development is explored. The following are covered: area ownership, history of region, population, employment, energy consumption, Madison formation, permeability and porosity of the Madison, flow of Madison wells, groundwater quality, water temperature, resource utilization, Midwest area, economic analysis of a

proposed district heating system, Casper Region, Douglas-Glenrock Corridor, and site data summaries. (MHR)

9069 (DOE/RA/50083—T1) Ketchum, Idaho site specific development analysis. Eastlake, W.B.; Sifford, A. (Idaho State Government, Boise (USA)). 1 Oct 1980. Contract FG51-80RA50083. 50p. NTIS, PC A03/MF A01.

The following subjects are covered: site description, resource evaluation, site specific application, development process, and a conceptual time line for development. (MHR)

9070 (DOE/SF/10497—T3) Geothermal energy in Idaho: site data base and development status. (Oregon Inst. of Tech., Klamath Falls (USA). Geo-Heat Utilization Center). Jul 1979. Contract AC03-79SF10497. 463p. NTIS, PC A20/MF A01.

The various factors affecting geothermal resource development are summarized for Idaho, including: resource data base, geological description, reservoir characteristics, environmental character, lease and development status, institutional factors, legal aspects, population and market, and development. (MHR)

9071 (DOE/SF/10497—T4) Geothermal energy in Alaska: site data base and development status. Markle, D.R. (Oregon Inst. of Tech., Klamath Falls (USA). Geo-Heat Utilization Center). Apr 1979. Contract AC03-79SF10497. 571p. NTIS, PC A24/MF A01.

The various factors affecting geothermal resource development are summarized for Alaska including: resource data base, geological description, reservoir characteristics, environmental character, base and development status, institutional factors, economics, population and market, and development potential. (MHR)

1502 Geology And Hydrology Of Geothermal Systems

9072 (DOE/ID/12079—T1) Geology of the Beowawe geothermal system, Eureka and Lander Counties, Nevada. Struhsacker, E.M. (Utah Univ., Salt Lake City (USA). Research Inst.). Jul 1980. Contract AC07-79ID12079. 131p. (ESL—37). NTIS, PC A07/MF A01.

A geologic study is described undertaken to evaluate the nature of structural and stratigraphic controls within the Beowawe geothermal system, Eureka and Lander Counties, Nevada. This study includes geologic mapping at a scale of 1:24,000 and lithologic logs of deep Chevron wells. Two major normal fault systems control the configuration of the Beowawe geothermal system. Active hot springs and sinter deposits lie along the Malpais Fault zone at the base of the Malpais Rim. The Malpais Rim is one of several east-northeast-striking, fault-bounded cuestas in north central Nevada. A steeply inclined scarp slope faces northwest towards Whirlwind Valley. The general inclination of the volcanic rocks on the Malpais dip slope is 5° to 10° southeast.

9073 (UCRL—52888) Effect of permeability on cooling of a magmatic intrusion in a geothermal reservoir. Lau, K.H. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 11 Jan 1980. Contract W-7405-ENG-48. 41p. NTIS, PC A03/MF A01.

Numerical modeling of the transient cooling of a magmatic intrusion is described in a geothermal reservoir that results from conduction and convection, considering the effects of overlying cap rock and differing horizontal and vertical permeabilities of the reservoir. These results are compared with data from Salton Sea Geothermal Field (SSGF). Multiple layers of convection cells are observed when horizontal permeability is much larger than vertical permeability. The sharp drop-off of surface heat flow experimentally observed at SSGF is consistent with the numerical results. The age of the intrusive body at SSGF is estimated to be between 6000 and 20,000 years.

1503 Geothermal Exploration And Exploration Technology

9074 (AD-A—083159) Evaluation of geothermal potential of Range Bravo 17 and the Shoal Site, Naval Air Station, Fallon. Final report, October 1978-September 1979. Whelan, J.A.; Rodgers, C.R.; Brown, J.; Neffewa, J. (Naval Weapons Center, China Lake, CA (USA)). Mar 1980. 39p. NTIS, PC A03/MF A01.

As part of the task of evaluating the geothermal potential of naval installations throughout the world, Range Bravo 17 and the Shoal Site, both located at the Naval Air Station, Fallon, Nev., were evaluated. An aeromagnetic survey was conducted; seismic refraction studies and extensive hydrologic studies were made; thermal gradient and heat flow data were taken; and water chemistry and mercury geochemistry analyses were made. The results of the study show that the geothermal potential of the Shoal area and Range Bravo 17 is low. It was concluded that further exploration of these sites is not warranted at this time.

9075 (DOE/ET/27002—4) Integral equation modeling of three-dimensional magnetotelluric response. Ting, S.C.; Hohmann, G.W. (Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics). Dec 1979. Contract AC07-79ET27002. 59p. (CONF-7811181—1). NTIS, PC A04/MF A01.

From 48. annual international SEG meeting; San Francisco, CA, USA (1 Nov 1978).

A three-dimensional (3D) volume integral equation was adapted to magnetotelluric (MT) modeling. Incorporating an integro-difference scheme increases the accuracy somewhat. Utilizing the two symmetry planes of a buried prismatic body and a normally incident plane wave source greatly reduces the required computation time and storage. Convergence checks and comparisons with one-dimensional (1D) and two-dimensional (2D) models indicate that the results are valid. Theoretical surface anomalies due to a 3D prismatic conductive body buried in a half-space earth are shown. Impedance tensor and magnetic transfer functions were obtained by imposing two different source polarizations. Manipulation of the impedance tensor and magnetic transfer functions yields the following MT quantities: apparent resistivity and phase, impedance polar diagrams, tipper direction and magnitude, principal directions, skew and ellipticity. With the preliminary analyses of these MT quantities, it was found that three-dimensionality is usually revealed by all of them. Two pairs of complementary parameters were recognized; apparent resistivity and phase, and skew and ellipticity. Because of surface charges at conductivity boundaries, low-frequency 3D responses are much different from 1D and 2D responses. Thus, in many cases, 3D models are required for interpreting MT data.

9076 (DOE/ET/28357—1) Magnetotelluric interpretations in a crustal environment. Final report. Madden, T.R. (Massachusetts Inst. of Tech., Cambridge (USA)). 1980. Contract AS02-77ET28357. 15p. NTIS, PC A02/MF A01.

Problems that arise in interpreting magnetotelluric measurements in complex geologic environments are approached by considering the low frequency approximation where the upper crust can be considered a thin layer of varying conductivity. The formulation of the thin layer problem, is modified to allow resistive coupling between the upper crust and the mantle. A new parameter arises, called the adjustment distance, which is the distance required for the current to readjust itself between the upper crust and the mantle when changes in crustal conductivity are encountered. This distance is given by the square root of the product of the integrated conductivity and the integrated resistivity across the crust (and some of the upper mantle). Layered media interpretations made on magnetotelluric data from areas that are closer to a conductivity boundary than the adjustment distance can be very misleading. Since the adjustment distance is often greater than 100 km, one has to consider more complex modelling in many situations. In order to simplify the modelling of the large region dictated by the adjustment distance the concept of a multiple scale analysis to the thin layer calculations was applied. A simple interpretation of actual field data from the Snake River Plains is given which illustrates the adjustment distance effect on magnetotelluric fields.

9077 **(SAND—80-1653) Kilauea Iki lava lake experiment plans.** Dunn, J.C.; Hills, R.G. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 64p. NTIS, PC A04/MF A01.

Twelve experimental studies are proposed to complete field laboratory work at Kilauea Iki lava lake. Of these twelve experiments, eleven do not require the presence of melt. Some studies are designed to use proven techniques in order to expand our existing knowledge, while others are designed to test new concepts. Experiments are grouped into three main categories: geophysics, energy extraction, and drilling technology. Each experiment is described in terms of its location, purpose, background, configuration, operation, and feasibility.

1504 Legal And Institutional Aspects

REFER ALSO TO CITATION(S) 9065, 9067

9078 **(DOE/ET/27174—T1) Geothermal development and land use/energy planning by the State of California and its political subdivisions.** (JM Energy Consultants, Inc., Los Angeles, CA (USA)). 30 Jul 1978. Contract AC03-78ET27174. 61p. NTIS, PC A04/MF A01.

The mechanisms in California law for the implementation of geothermal planning and their impacts are examined, first, at the State level upon the California Energy Commission and the Division of Oil and Gas in the Department of Conservation. Next, after some background on county planning in California, the unique situation in the counties of greatest geothermal potential is discussed. These include: Imperial County and the four Geysers Counties (Sonoma, Napa, Mendocino, and Lake), as well as their joint powers agency - G.R.I.P.S. (MHR)

9079 **(DOE/PE/70090—T2) Geothermal industry assessment.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). Jul 1980. Contract AC03-79PE70090. 321p. NTIS, PC A14/MF A01.

An assessment of the geothermal industry is presented, focusing on industry structure, corporate activities and strategies, and detailed analysis of the technological, economic, financial, and institutional issues important to government policy formulation. The study is based principally on confidential interviews with executives of 75 companies active in the field. (MHR)

1506 Environmental Aspects And Waste Disposal

REFER ALSO TO CITATION(S) 8738

9080 **(LA—8613C) Workshops to rate and assign air and water issues for hydrothermal energy development.** Williams, J.M.; Wewerka, E.M. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 59p. NTIS, PC A04/MF A01.

The presentations, discussions, and recommendations associated with a semiformal, 2-day workshop organized and hosted by Los Alamos Scientific Laboratory personnel at Los Alamos, NM, for March, 11-12, 1980, and an informal, 2-day workshop hosted by Lawrence Livermore Laboratory at Livermore and Konocti Harbor, CA, from April 15-16, 1980 are described briefly. These workshops were not conducted to determine what the problems are, but rather to determine which ones should be addressed and who should address them. Brief reviews of issues identified by previous workshops and studies are included as background.

9081 **(LA—8633-MS) Meteorological analysis for Fenton Hill, 1979.** Barr, S.; Wilson, S.K. (Los Alamos Scientific Lab., NM (USA)). Jan 1981. Contract W-7405-ENG-36. 24p. NTIS, PC A02/MF A01.

Three years of meteorological data have been collected at the Fenton Hill site to establish a local climatic baseline, transport and diffusion climatology, and an initial site for an eventual Valles Caldera meteorological network. Tower-based wind and temperature data at 15 m above ground were supplemented during 1979 with precipitation, humidity and pressure measurements, and a limited program of upper winds. Preliminary analysis of the data has been made to identify major topographic and meteorological driving forces affecting the local climatic variations on diurnal and seasonal time scales. The site is quite high and exposed enough tht external influences such as gradient wind flow and thunderstorms tend to dominate over purely local driving forces in determining climate. Locally generated wind circulations are identifiable at night but tend to be weak and sporadic. The presence of topographic obstacles on the 10- to 100-km scale is observed in the winds.

9082 **(UCID—18903) Management plan for fiscal year 1981: Environmental Control Technology Project, geothermal development.** Morris, W.F.; Stephens, F.B. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 14 Oct 1980. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01.

The management of the following four assessment tasks are discussed: current progress in H_2S abatement technology; solid wastes from geothermal power production operations: characterization, handling, and disposal; problems associated with the use of agricultural drainage water for geothermal power plant cooling in the Imperial Valley; and liquid dominated, low total dissolved solids geothermal resources: characterization and evaluation of potential problems due to composition. (MHR)

1508 Geothermal Power Plants

9083 **(DOE/ET/27145—T1) Analysis of mass transfer processes in geothermal power cycles utilizing direct contact heat exchange. Report of work, September 21, 1978 to September 30, 1979.** Knight, J.J.; Perona, J.J. (Tennessee Univ., Knoxville (USA). Dept. of Chemical, Metallurgical and Polymer Engineering). 1979. Contract AC03-78ET27145. 57p. NTIS, PC A04/MF A01.

A computer program was developed which calculates the isobutane content of the spent brine and the liquid-vapor distribution of carbon dioxide and hydrogen sulfide throughout the components of a geothermal power plant using direct contact heat exchange. The program model assumes separate boiler and preheater vessels, with the preheater being a spray tower. The condenser model is a horizontal tube surface condenser with condensation on the outside. The program was written in Fortran language. The Fortran source deck consists of 976 cards. The program utilizes 320K for compilation and 72K for execution on an IBM 370/3031. Sample cases were run which illustrate the effects of salt concentration in the brine and isobutane-to-brine ratio on isobutane and noncondensible gas content of the spent brine.

9084 **(IDO—1523-5) Comparison between a spray column and a sieve tray column operating as liquid-liquid heat exchangers.** Keller, A.; Jacobs, H.R.; Boehm, R.F. (Utah Univ., Salt Lake City (USA). Dept. of Mechanical Engineering). Dec 1980. Contract AS07-76ID01523. 130p. NTIS, PC A07/MF A01.

The performance of a spray column and a sieve tray column was compared as a liquid-liquid heat exchanger. In carrying out these studies a 15.2 cm (6.0 in.) diameter column, 183 cm (6.0 ft) tall was utilized. The performance of the spray column as a heat exchanger was shown to correlate with the model of Letan-Kehat which has as a basis that the heat transfer is dominated by the wakeshedding characteristics of the drops over much of the column length. This model defines several hydrodynamic zones along the column of which the wake formation zone at the bottom appears to have the most efficient heat transfer. The column was also operated with four perforated plates spaced two column diameters apart in order to take advantage of the wake formation zone heat transfer. The plates induce coalescence of the dispersed phase and reformation of the drops, and thus cause a repetition of the wake formation zone. It is shown that the overall volumetric heat transfer coefficient in a perforated plate column is increased by a minimum of eleven percent over that in a spray column. A hydrodynamic model that predicts the performance of a perforated plate column is suggested.

1509 Geothermal Engineering

9085 (DOE/SF/11451—1) Geothermal reservoir engineering computer code comparison and validation calculations using MUSHRM and CHARGR geothermal reservoir simulators. Pritchett, J.W. (Systems, Science and Software, La Jolla, CA (USA)). Nov 1980. Contract AC03-80SF11451. 129p. (SSS-R—81-4749). NTIS, PC A07/MF A01.

The essential features of the reservoir codes CHARGR and MUSHRM are described. Solutions obtained for the problem set posed by DOE are presented. CHARGR was used for all six problems; MUSHRM was used for one. These problems are: the 1-D Avdonin solution, the 1-D well test analysis, 2-D flow to a well in fracture/block media, expanding two-phase system with drainage, flow in a 2-D areal reservoir, and flow in a 3-D reservoir. Results for the last problem using both codes are compared. (MHR)

9086 (LA—8428) Geothermal energy enhancement by thermal fracture. Demuth, R.B.; Harlow, F.H. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 70p. NTIS, PC A04/MF A01.

A large, vertical, circular fracture created deep within hot rock is connected to the surface through two holes. The inlet provides a source of cold water and the outlet extracts heated water. Cooling of the rock produces thermal stresses that fracture the rock adjacent to the primary crack, thereby enhancing the heat extraction rate by means of convective transport. The properties of the thermal fracture network vary with position and time. The REX code for high-speed computer was written and used to study the coupled processes of primary-crack flow and lateral thermal fracture heat transport. Calculations for elapsed times of 100 y show that thermal fracture enhancement can double the heat extraction rate over the results from conduction alone. Long-term enhancement predictions depend on data from rock-mechanics studies, which the REX code is prepared to accept as they become available.

9087 (LA-UR—80-3496) Comparison of two hot dry rock geothermal reservoirs. Murphy, H.D.; Tester, J.W.; Potter, R.M. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 8p. (CONF-801233—2). NTIS, PC A02/MF A01.

From 6. annual workshop on geothermal reservoir engineering; Stanford, CA, USA (16 Dec 1980).

Two hot dry rock (HDR) geothermal energy reservoirs were created by hydraulic fracturing of granite at 2.7 to 3.0 km (9000 to 10,000 ft) at the Fenton Hill site, near the Valles Caldera in northern New Mexico. Both reservoirs are research reservoirs, in the sense that both are fairly small, generally yielding 5 MWt or less, and are intended to serve as the basic building blocks of commercial-sized reservoirs, consisting of 10 to 15 similar fractures that would yield approximately 35 MWt over a 10 to 20 yr period. Both research reservoirs were created in the same well-pair, with energy extraction well number 1 (EE-1) serving as the injection well, and geothermal test well number 2 (GT-2) serving as the extraction, or production, well. The first reservoir was created in the low permeability host rock by fracturing EE-1 at a depth of 2.75 km (9020 ft) where the indigenous temperature was 185°C (364°F). A second, larger reservoir was formed by extending a small, existing fracture at 2.93 km (9620 ft) in the injection well about 100 m deeper and 10°C hotter than the first reservoir. The resulting large fracture propagated upward to about 2.6 km (8600 ft) and appeared to Rave an inlet-to-outlet spacing of 300m (1000 ft), more then three times that of the first fracture. Comparisons are made with the first reservoir. Evaluation of the new reservoir was accomplished in two steps: (1) with a 23-day heat extraction experiment that began October 23, 1979, and (2) a second, longer-term heat extraction experiment still in progress, which as of November 25, 1980 has been in effect for 260 days. The results of this current experiment are compared with earlier experiments.

9088 (LA-UR—80-3586) Directional drilling and equipment for hot granite wells. Williams, R.E.; Neudecker, J.W.; Rowley, J.C.; Brittenham, T.L. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 21p. (CONF-810105—2). NTIS, PC A02/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

The following drilling equipment and experience gained in drilling to date are discussed: positive displacement motors, turbodrills, motor performance experience, rotary-build and rotary-hold results, steering devices and surveying tools, shock absorbers, drilling and fishing jars, drilling bits, control of drill string drag, and control of drill string degradation. (MHR)

9089 (LA-UR—80-3604) Drilling fluids and lost circulation in hot dry rock geothermal wells at Fenton Hill. Nuckols, E.B.; Miles, D.; Laney, R.; Polk, G.; Friddle, H.; Simpson, G.; Baroid, N.L. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 24p. (CONF-810105—1). NTIS, PC A02/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

Geothermal hot dry rock drilling activities at Fenton Hill in the Jemez Mountains of northern New Mexico encountered problems in designing drilling fluids that will reduce catastrophic lost circulation. Four wells (GT-2, EE-1, EE-2, and EE-3) penetrated 733 m (2405 ft) of Cenozoic and Paleozoic sediments and Precambrian crystalline rock units to +4572 m (+15,000 ft). The Cenozoic rocks consist of volcanics (rhyolite, tuff, and pumice) and volcaniclastic sediments. Paleozoic strata include Permian red beds (Abo Formation) and the Pennsylvanian Madera and Sandia Formations, which consist of massive limestones and shales. Beneath the Sandia Formation are igneous and metamorphic rocks of Precambrian age. The drilling fluid used for the upper sedimentary formations was a polymeric flocculated bentonite drilling fluid. Severe loss of circulation occurred in the cavernous portions of the Sandia limestones. The resultant loss of hydrostatic head caused sloughing of the Abo and of some beds within the Madera Formation. Stuck pipe, repetitive reaming, poor casing cement jobs and costly damage to the intermediate casing resulted. The Precambrian crystalline portion of the EE-2 and EE-3 wells were directionally drilled at a high angle, and drilled with water as the primary circulating fluid. Due to high temperatures [approximately 320°C (608°F) BHT] and extreme abrasiveness of the deeper part of the Precambrian crystalline rocks, special problems of corrosion inhibition and of torque friction were incurred.

9090 (PNL—3534) Application of linear polarization techniques to the measurement of corrosion rates in simulated geothermal brines. Danielson, M.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1980. Contract AC06-76RL01830. 29p. NTIS, PC A03/MF A01.

The linear polarization of polarization resistance (PR) technique was investigated in high- and low-salinity geothermal brines at 150 and 250°C on a low carbon steel (A53B) and a ferritic stainless steel (E-brite 26-1) with and without the presence of oxygen in the brine. There was good agreement between weight loss data and the results from linear polarization data. Oxygen generally accelerated the corrosion rate, and in the presence of oxygen the usual form of the PR equation must be replaced by the mass transfer equation to predict corrosion rates correctly. Results of the study were compared with the corrosion rate output of commercial PR instrumentation, and it was concluded that this instrumentation is adequate for field investigations in which oxygen is absent. However, when oxygen is present, commercial instruments may underestimate actual corrosion rates considerably.

9091 (SAND—80-1090) Geothermal drill pipe corrosion test plan. Caskey, B.C.; Copass, K.S. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1980. Contract AC04-76DP00789. 40p. NTIS, PC A03/MF A01.

Plans are presented for conducting a field test of drill pipe corrosion, comparing air and nitrogen as drilling fluids. This test will provide data for evaluating the potential of reducing geothermal well drilling costs by extending drill pipe life and reducing corrosion control costs. The 10-day test will take place during fall 1980 at the Baca Location in Sandoval County, New Mexico.

9092 **(SAND—80-2633C) Influence of steam/water relative permeability models on predicted geothermal reservoir performance: a sensitivity study.** Reda, D.C.; Eaton, R.R. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 7p. (CONF-801233—1). NTIS, PC A02/MF A01.

From 6. annual workshop on geothermal reservoir engineering; Stanford, CA, USA (16 Dec 1980).

The objective of the present effort was to conduct a sensitivity study, using the SHAFT code, to demonstrate the influence of various RPMs (relative permeability models) on predicted geothermal reservoir performance. A basic model devised to accomplish this goal was one which would allow each of the four noted saturation limits to be specified (input) independently; k/sub L/(s) and k/sub G/(s) were then modeled as having a linear dependence on s between these specified limits. A one-dimensional problem was chosen for study. An infinite porous reservoir containing liquid water at $p_1 = 10.4$ bars and $T_1 = 180°C$ was connected to a permeable stratum initially at the same pressure and temperature. The stratum was assumed to be bounded above and below by layers of impermeable rock. Heat conduction from these layers to the stratum was neglected. At time (t) zero, a well-bore was joined to the stratum, i.e., a boundary condition of $p_2 = 1.06$ bars was specified at the stratum exit. The transient problem was then solved for p(x,t), T(x,t) and s(x,t) until a steady-state solution was achieved. In all cases, a short region of liquid water flow, followed by an extended region of two-phases, steam/water, flow was predicted to occur. Reservoir performance or output was quantified by the product of the total, steady-state, mass flux (W) and the mixture enthalpy (H) at the stratum exit (i.e., into the well). All such steady-state convective energy fluxes (WH) were non-dimensionalized by the product (WH/sub REF/) predicted to occur at the same location for a reference case RPM. The reference case utilized is one which possessed no trapped phases, while still maintaining the stated linear dependence of k/sub L/ and k/sub G/ on s. (MHR)

9093 **(UCID—18917) Studies of brine chemistry and scaling at the Salton Sea geothermal field, 1977-1979. Final report.** Harrar, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1981. Contract W-7405-ENG-48. 45p. NTIS, PC A03/MF A01.

Summarized are the results of investigations of brine chemistry, the effects of brine acidification and organic additives on the rate of scale formation and scale composition, and the use of other additives for scale control. A bibliography of reports describing these studies is included. Recommendations are given for techniques and approaches for further testing of additives for silica scale control.

1510 Direct Energy Utilization

REFER ALSO TO CITATION(S) 8748, 9069

9094 **(AD-A—085061) Space heating at the Naval Air Station, Fallon, Nevada - an economic analysis of a geothermal alternative. Master's thesis.** Kovach, R.G.; Lewis, H.M. (Naval Postgraduate School, Monterey, CA (USA)). Dec 1979. 64p. NTIS, PC A04/MF A01.

This thesis explores the economic feasibility of applying geothermally heated hot water for space heating purposes at the Naval Air Station, Fallon, Nevada. A generalized survey of current geothermal technology is presented, followed by a discussion of geothermal cost factors. Two recent separate studies, one by the Public Works Center, Naval Weapons Station, China Lake, CA., and the other by Western Division, Naval Facilities Engineering Command, San Bruno, CA., which address the geothermal heating application at NAS Fallon, are synopsized. Using the benefit/cost results of these studies, a more detailed economic evaluation is then made of the proposed alternatives. Results of these economic extensions indicate that a geothermal heating system at NAS Fallon is a basically sound investment, given the correctness of assumptions made in each study. Several conclusions and recommendations are presented based on the study results.

9095 **(DGE—4014-14) Geothermal hydrothermal direct heat use: US market size and market penetration estimates.** El Sawy, A.H.; Entingh, D.J. (Mitre Corp., McLean, VA (USA). METREK Div.). Sep 1980. Contract AC01-77ET28505. 165p. NTIS, PC A08/MF A01.

This study estimates the future regional and national market penetration path of hydrothermal geothermal direct heat applications in the United States. A Technology Substitution Model (MARPEN) is developed and used to estimate the energy market shares captured by low-temperature (50 to 150°C) hydrothermal geothermal energy systems over the period 1985 to 2020. The sensitivity of hydrothermal direct heat market shares to various government hydrothermal commercialization policies is examined. Several substantive recommendations to help accelerate commercialization of geothermal direct heat utilization in the United States are indicated and possible additional analyses are discussed.

9096 **(DOE/ET/27256—T1) Heating facilities: Klamath Lutheran Church, Klamath Falls, Oregon.** (Oregon Inst. of Tech., Klamath Falls (USA)). Aug 1980. Contract FG06-79ET27256. 19p. NTIS, PC A02/MF A01.

The Klamath Lutheran Church is a masonry structure with cathedral ceiling containing approximately 5800 sq ft of floor area. This building is currently heated by two duct furnaces and a unit heater all of which are gas fired. An Educational Wing of approximately 6300 sq ft was added in 1958. This building, containing 2 assembly rooms and a number of classrooms is of uninsulated frame construction, with extensive glass area. A gas-fired boiler supplying finned tube radiators currently heats this wing. Four specific options for displacing all or part of the heating duty with geothermal were examined. These options are: case 1 - drilling a production and injection well on the property and using the resultant hot water (180°F) to heat the entire facility; case 3 - using effluent from the Klamath Union High School to heat the entire facility; no well drilling required; case 2 - using effluent from the Klamath Union High School to heat only the church building; the present gas boiler would heat the Educational Wing; and case 4 - drilling a production and injection well on the property and using the resulting water (70°F) to supply a water-to-water heat pump. Of the four cases examined, case 3 (heating of both the church building and educational wing with effluent from the Klamath Union High School) seems to offer the greatest potential and earliest simple payback period. (MHR)

9097 **(DOE/ET/27256—T2) Geothermal aquaculture: a guide to freshwater prawn culture.** Hayes, A.; Johnson, W.C. (Oregon Inst. of Tech., Klamath Falls (USA). Geo-Heat Utilization Center). May 1980. Contract FG06-ET27256. 25p. NTIS, PC A02/MF A01.

Biological data of the Malaysian prawn, Macrobrachium rosenbergii, are summarized. A history on its rearing techniques is given, but through the use of geothermal water or industrial warm water effluent, its range can be expanded. The use of wasted geothermal water at the Oregon Institute of Technology for prawn ponds is noted. Pond management and design; the hatchery design and function for larval culture; and geothermal applications (legal aspects and constraints) are discussed. (MCW)

9098 **(DOE/ET/27256—T3) Heat pump system: A.C. Davis High School.** (Oregon Inst. of Tech., Klamath Falls (USA)). Jul 1980. Contract FG06-79ET27256. 45p. NTIS, PC A03/MF A01.

With the evidence of geothermal resources in the area of Davis High School, a study to heat the school using water-to-water heat pumps was made. Results of the study of the 7-building 179,100 square feet Yakima, Washington school are presented. Four water-to-water heat pumps, an underground water distribution system, and several new terminal units would be installed under the proposed design. The estimated capital cost of the new system is $830,000. Annual energy savings due to reduced natural gas purchases are expected to be about 200,000 therms/y. Availability of geothermal water, heating load calculations, the geothermal system, and modifications planned for the existing buildings are discussed. Details on the economics of the system are analyzed.

9099 (DOE/ET/27256—T4) Heating facilities: Indian Valley Hospital, Greenville, California. (Oregon Inst. of Tech., Klamath Falls (USA)). Oct 1980. Contract FG06-79ET27256. 13p. NTIS, PC A02/MF A01.

Indian Valley Hospital is a 36 bed publicly-owned rural hospital. Adjacent to the hospital is a hot spring that is utilized by a commercial spa. Slightly further east is a agricultural well that produces 450 GPM of 85°F water. The hospital is a single story building of concrete construction with a total floor area of about 11,000 square feet. Existing heating is by electric resistance wire beneath the flooring. Domestic hot water is furnished by propane fired heaters, with some temperature boost from electric water heaters. Portions of the electric resistance system have failed, and failure of the remaining portion is probable. It is economically feasible to heat Indian Valley Hospital using a water to water heat pump. Low temperature geothermal water from a relatively shallow well will furnish the heat source for the heat pump which will produce a 140°F circulating hot water stream. This hot water will supply the space heating needs and the bulk of the domestic hot water. The production and injection wells, a heat pump, and natural draft convectors are the major components of the system. Estimated capital cost is $120,000. Propane purchases will be eliminated, and annual electrical purchases reduced from about 360,000 KWH to about 164,000 KWH. This results in a savings at the start of the first year of $12,476. This savings, less operating costs, when applied with escalation considerations over a period of twenty years, will result in a rate of return on the $120,000 investment of 13.4%. If the project is financed with 8% bonds, a $201,354 surplus will accumulate over the 20 years after debt service and bond retirement.

9100 (DOE/ET/27256—T5) Geothermal space and water heating facilities: Schooler apartments, Klamath Falls, Oregon. (Oregon Inst. of Tech., Klamath Falls (USA)). 1980. Contract FG06-79ET27256. 10p. NTIS, PC A02/MF A01.

A feasibility study is presented of using geothermal water for space and domestic water heating of 50 apartment units of approximately 1000 square feet each located in eight buildings. The alternative system considered uses individual 10 kW electric furnaces and electric water heaters.

9101 (DOE/RA/50108—T1) Market study for direct utilization of geothermal resources by selected sectors of economy. (Sterling Hobe Corp., Washington, DC (USA)). Aug 1980. Contract AC01-80RA50108. 225p. NTIS, PC A10/MF A01.

A comprehensive analysis is presented of industrial markets potential for direct use of geothermal energy by a total of six industry sectors: food and kindred products; tobacco manufactures; textile mill products; lumber and wood products (except furniture); chemicals and allied products; and leather and leather products. A brief statement is presented regarding sectors of the economy and major manufacturing processes which can readily utilize direct geothermal energy. Previous studies on plant location determinants are summarized and appropriate empirical data provided on plant locations. Location determinants and potential for direct use of geothermal resources are presented. The data was gathered through interviews with 30 senior executives in the six sectors of economy selected for study. Probable locations of plants in geothermal resource areas and recommendations for geothermal resource marketing are presented. Appendix A presents factors which impact on industry location decisions. Appendix B presents industry executives interviewed during the course of this study. (MHR)

1520 Geothermal Data And Theory

9102 (LBL—11586) Viscosity of NaCl and other solutions up to 350°C and 50 MPa pressures. Phillips, S.L.; Ozbek, H.; Igbene, A.; Litton, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1980. Contract W-7405-ENG-48. 80p. (CONF-800814—30). NTIS, PC A05/MF A01.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; Las Vegas, NV, USA (24 Aug 1980).

Experimental values for the viscosity of sodium chloride solutions are critically reviewed for application to geothermal energy. Data published recently by Kestin, Los, Pepinov, and Semenyuk as well as earlier data are included. A theoretically based equation for calculating relative viscosity was developed, and used to generate tables of smoothed values over the ranges 20°C to 350°C, 0 to 5 m and pressures up to 50 MPa. The equation reproduces selected data to an average of better than 2 percent over the entire range of temperatures and pressures. Selected tables of data are included for KCl up to 150°C, $CaCl_2$ solutions up to 100°C, and for mixtures of NaCl with KCl and $CaCl_2$. Recommendations are given for additional data needs.

17 WIND ENERGY

1701 Availability (climatology)

9103 (CONF-800995—, pp 255-261) **Federal wind energy program for wind resource assessment and siting: an overview.** Wendell, L.L. (Battelle Pacific Northwest Labs., Richland, WA). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

In this overview, the technical progress in wind resource assessment and siting is highlighted from the work of the Pacific Northwest Laboratory (PNL) and its subcontractors. One of the major efforts in the program is the completion of the regional wind energy assessments covering the United States and its territories. Also, methods for selecting the specific locations of wind turbines have been developed for both large and small machines.

9104 (DOE/ET/20280—T1) Preliminary user's guide for the NOABL objective analysis code. Special report, 15 June 1977-15 June 1978. Phillips, G.T. (Science Applications, Inc., La Jolla, CA (USA)). Jul 1979. Contract AC06-77ET20280. 118p. NTIS, PC A06/MF A01.

The NOABL code was developed to provide the user with an economical windfield predictor. The model produces three dimensional, terrain-dependent, divergence-free windfields given observed surface and/or upper-air data as input. The model may be run in either of two coordinate systems. In real space, the irregular surface boundary is approximated using obstacle cells to represent the terrain in a stairstep fashion. In sigma space, the irregular surface boundary is removed for computational purposes by a coordinate transformation in which the terrain surface also becomes a coordinate surface. Regardless of the coordinate system used, NOABL follows a procedure of extrapolating and interpolating the input data to determine an estimated three-dimensional windfield on a specified finite difference grid. This prospective windfield is then adjusted to account for terrain effects and atmospheric stability considerations constrained by the condition that the resulting windfield be nondivergent.

1704 Economics

9105 (RFP—3120/3533/80-13) SWECS cost of energy based on life cycle costing. Briggs, W.R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). May 1980. Contract AC04-76DP03533. 55p. NTIS, PC A04/MF A01.

Various Small Wind Energy Conversion Systems (SWECS) being developed under contract to Rocky Flats were subjected to a life cycle costing (LCC) analysis to project the cost of energy available from these systems. SWECS sizes considered were 1-2 kW, 8 kW, and 40 kW units. Systems costs were based on an assumed sales volume of 1000 units of each SWECS per year. The results of the LCC analysis show SWECS cost of energy to be competitive with grid electricity costs of energy over the projected lifetimes of the SWECS depending on competing energy cost at the SWECS location, average wind velocity, and efficiency of utilization of SWECS-generated energy.

9106 **(RFP—3127/05480/80-11) SWECS qualifications for state programs. Final report.** Kornreich, T.R.; Devine, D. (Science Applications, Inc., McLean, VA (USA)). Jul 1980. Contract AC04-76DP03533. 36p. NTIS, PC A02/MF A01.

The purpose of this report is to assist in establishing the needed basis to be used by states to evaluate SWECS inclusion in tax incentive programs to encourage the use of renewable energy systems. Three prototypical qualifications documents are included in this report reflecting three levels of stringency: very demanding, moderately demanding, and relatively relaxed sets of requirements that may be placed upon SWECS by the states. Qualifications requirements already in effect in certain states as well as information obtained from interviews with responsible officials in a sample of ten states were used in this study. This information was analyzed and a range of options for defining SWECS qualifications was established.

9107 **(RFP—3136/3533/80/18) Small wind systems technology assessment. State of the art and near term goals.** Bollmeier, W.S.; Butterfield, C.P.; Cingo, R.P.; Dodge, D.M.; Hansen, A.C.; Shepherd, D.C.; Tangler, J.L. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Feb 1980. Contract AC04-76DP03533. 98p. NTIS, PC A05/MF A01.

Commercially available small wind conversion systems (SWECS), DOE-funded prototype SWECS, and possible second generation advanced concepts are assessed from the standpoint of several key Figures-of-Merit including cost of energy, dollars per pound, kilowatt hours per year per pound, and kilowatt hours per year per square meter of rotor area. The reliability, performance, and installation and maintenance costs of these systems are also assessed. It is concluded that current SWECS, while nearing the threshold of competitiveness with conventional energy sources, are inhibited from reaching their lowest cost potential by the use of off-the-shelf components, less than optimum rotor designs, and (in some cases) overly complicated control systems. The comparison of improved DOE prototypes and possible advanced concept SWECS shows that, in many size ranges, considerable reductions in energy cost can be achieved.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 8984, 9103, 9104, 9107, 9228, 9229

9108 **(RFP—3135/3533/80-19) Wind machine fatigue analysis and life prediction.** Waldon, C.A. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Apr 1980. Contract AC04-76DP03533. 61p. NTIS, PC A04/MF A01.

Wind machines are, inherently, generators of fatigue. This is true for all types and sizes. Testing at the Rocky Flats Small Wind Systems Test Center has shown that fatigue is the dominant mode of structural failure and its prediction the hardest task for the manufacturer. The objective of this paper is to present a technique, developed by the author, for measuring fatigue and predicting fatigue life for different wind regimes. Presented herein are the techniques for locating high stress measuring points, obtaining data, using computer programs for calculating fatigue reduction, and finally predicting fatigue life.

9109 **(RFP—3148/3533/80-16) Pinson C2E wind turbine generator failure analysis and corrective design modification.** Carr, M.J.; Grotsky, V.K.; Sexton, J.H. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Mar 1980. Contract AC04-76DP03533. 26p. NTIS, PC A03/MF A01.

On December 4, 1978 wind speeds at the Rocky Flats Small Wind Systems Test Center reached 42 m/s (94 mph). During a routine inspection of all wind machines following this windstorm, two failures were observed on the Pinson C2E Wind Turbine Generator. One failure was fatigue cracks which formed on plates welded to the rotor shaft. The second failure was a number of cracks in the skin of all three blades. Although the possibility exists that the high winds of December 4, 1978 contributed to these failures, no conclusive data exist substantiating this theory. In fact, the C2E's feathering mechanism functioned normally during the windstorm; thereby, controlling rotor overspeed, a potential cause of damage.

9110 **(RFP—3149/3533/80-17) Dunlite model 81/002550 wind turbine generator. Final test report.** Higashi, K.K. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Feb 1980. Contract AC04-76DP03533. 22p. NTIS, PC A02/MF A01.

The Dunlite Model 81/002550 Wind Turbine Generator has met all manufacturer claims of performance and reliability. The machine operated satisfactorily in winds up to the manufacturer rated survival speed of 36 m/s (80 mph). In addition, the Dunlite operated in winds exceeding 22.5 m/s (50 mph) for eight hours without incurring damage. Major damage to the machine occurred when wind speeds exceeded 40.3 m/s (90 mph). If winds of this velocity are expected, the manufacturer offers a high speed model of this wind turbine designed to withstand winds of 49.5 m/s (110 mph). Testing of the Dunlite indicated that the machine is capable of producing its rated output of 2 kW at 11 m/s (25 mph).

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

9111 **(AD-A—082716) Potential sites for joint venture biomass fueled power plants. Final report.** (Ultrasystems, Inc., Irvine, CA (USA)). 2 Jan 1980. Contract DAAK70-79-M-4882. 150p. NTIS, PC A07/MF A01.

The US Army is investigating wood-fired boilers. One application is for wood fuels to fire fixed power plant installations where the technology is well proven. Approximately 170 Army bases were evaluated for their heating and electrical needs versus fuel availability from on-base forests. Approximately 20 bases met the minimum demand and resource criteria. Potential joint venture partner classes were identified as new Contractor Owned/Contractor Operated (COCO) entrepreneurs; existing utilities and industries in the vicinity of the bases; and existing Government Owned/Contractor Operated (GOCO) entrepreneurs.

9112 **(AD-A—082773) Production and use of densified refuse-derived fuel (DRDF) in military central heating and power plants. Final report.** Hathaway, S.A.; Lin, J.S.; Mahon, D.L.; West, B.; Marsh, R. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Mar 1980. Contract MIPR-FY8952-78-65012. 104p. NTIS, PC A06/MF A01.

This study appraises the state of the art of production and use of densified refuse-derived fuel (DRDF) in military-scale (25 to 200 MBtu per hour) central heating and power plants. It found that few performance and economic data exist for military-scale DRDF production unit operations. Although theoretical modeling of some operations (shredding, air classifying, pelleting) is generally well developed, field verification of the models is beleaguered by continued alterations of in-place equipment design to improve performance, lack of a uniform method to characterize refuse input to processes, and absence of an industry-wide commitment to monitor equipment performance. Although nearly two dozen DRDF tests have been conducted, they have been short-term experiments that have not followed the scientific method and have been inconclusive regarding long-term DRDF use in military heating and power plants. As a result, proper and realistic specification of DRDF for military procurement cannot be made. The study also found that lack of operating data, standard analytical procedures, and experience in military-scale DRDF systems engenders high risk in their implementation at present. The study found that proper management and disposal of byproducts and potential environmental pollutants from DRDF production and use can be achieved with available technology, but that the costs of control are significant.

9113 **(CONF-810309—1) Materials exposure test facilities for varying low-Btu coal-derived gas.** Nakaishi, C.V.; Carpenter, L.K. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). 1980. Contract AC05-77ET13133. 14p. NTIS, PC A02/MF A01.

From ASME gas turbine conference; Houston, TX, USA (9 Mar 1981).

As a part of the United States Department of Energy's High Temperature Turbine Technology Readiness Program, the Morgantown Energy Technology Center is participating in the Ceramics Corrosion/Erosion Materials Study. The objective is to create a technology base for ceramic materials which could be used by stationary gas power turbines operating in a high-temperature, coal-derived, low-Btu gas products of combustion environment. Two METC facilities have been designed, fabricated and will be operated simultaneously exposing ceramic materials dynamically and statically to products of combustion of a coal-derived gas. The current studies will identify the degradation of ceramics due to their exposure to a coal-derived gas combustion environment.

9114 **(EPRI-AP—1598) High-reliability gas turbine combined-cycle development program. Phase I. Final report.** Strong, R.E.; Amos, D.J.; Eagle, K.H.; Francois, G.L. (Westinghouse Electric Corp., Concordville, PA (USA). Combustion Turbine Systems Div.). Nov 1980. 362p. NTIS, PC A16/MF A01.

The Electric Power Research Institute, Inc., awarded the Combustion Turbine Systems Division of Westinghouse Electric Corporation a contract under Phase I of Research Project 1187 to develop a conceptual centerline design of a highly reliable combustion-turbine combined-cycle (CTCC) electric power generating plant having the twin design availability goals of 0.95 for the combustion-turbine (CT) engine and 0.90 for the combined-cycle (CC) plant, together with a CT engine starting reliability of 0.99. The work and results off six interrelated tasks are described in this report: (1) reliability analyses of current Westinghouse CT engines/plants and development of methodologies for assessing/predicting CT unit and CC plant reliability/availability, (2) eight CT-unit/CC-plant reliability design trade-off studies featuring cost-of-electricity (less fuel cost) as the evaluation parameter, (3) high-reliability CT unit and CC plant conceptual designs based on the results of the first two tasks, (4) definition of technology research projects required to complete development of the conceptual CTCC plant, (5) analyses of the conceptual designs to determine what modifications are required for peaking duty application and use of lower grade petroleum and coal-derived fuels, and (6) analyses of installed and current-design Westinghouse CT engines/CC plants to determine what retrofit modifications and design changes can be made to economically improve their availability.

9115 **(EPRI-AP—1599(Vol.1)) High-reliability gas turbine combined-cycle development program: Phase I.** Boenig, F.H.; Lewis, J.H. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). Oct 1980. 544p. NTIS, PC A23/MF A01.

Results are presented of Phase I of a multi-phase program leading to the development of a High Reliability Gas Turbine. The engine would be used for the base load, combined cycle application starting in the mid-1980's. The design, with primary emphasis on reliability, recognizes the need on the part of the electric utility user for high operating availability together with low maintenance cost to take full advantage of the capital cost and efficiency advantage offered by the combined cycle plant. Phase I was a conceptual design study of both the gas turbine itself and the full plant. Reliability for all component equipment was emphasized from the very outset. In the case of the gas turbine, high reliability was reflected in a concept that features ruggedness and simplicity. Ease of maintenance was provided through structural simplicity and modularization. Component designs for the gas turbine were selected on the basis of a review of past operational experience and an in-depth statistical reliability analysis. Design details were then determined using trade-off and parametric studies. Reliability in the auxiliary and balance of plant waste heat recovery equipment was provided by redundancy of critical components as well as the use of proven equipment. Careful attention was paid to developing a concept for a highly reliable control system that blends automatic operation with manual override for operator intervention. A condition monitoring system to provide alerts for incipient shut down conditions was also incorporated into the control design concept. The final gas turbine design is a 107 MW, single-shaft engine. Projected availability for the final engine installed in a combined cycle plant is 92%. This design will serve as a firm point of departure for the preliminary design to follow during the Phase II program.

9116 **(EPRI-CS—1653) Corrosion problems in coal-fired boiler superheater and reheater tubes: fireside corrosion. Final report.** Rehn, I.M. (Foster Wheeler Corp., Livingston, NJ (USA)). Nov 1980. 429p. NTIS, PC A19/MF A01.

This program was conducted to develop improved alloys for superheater and reheater tubes in direct coal-fired steam generators in order to extend the service life of the tubes, and to evaluate materials for use at higher operating temperatures than currently in use. The program consisted of a broad literature review and laboratory evaluation involving 19 commercial and semicommercial alloys, 19 custom-melted alloys and 18 types of high-temperature coatings, subjecting them to flowing flue gas and molten alkali-iron trisulfate ash at 1250 and 1450°F (675 and 790°C). The commercial and semicommercial alloys suffered severe attack and pitting under the laboratory fireside test environment at 1250°F (675°C). In the custom-melted group, the best alloy (25%Ni-20%Cr-2%Al-2.4%Si) generated a dense, adherent scale which reduced pitting by a factor of four when subjected to the molten trisulfate. The character of the pitting attack is best described as an electrochemical mechanism where the molten trisulfate provides the electrolyte and transfers away the metal consumed at the active anodic areas. Protective scales were observed only on a few alloys of higher silicon content; these alloys are believed to offer significant improvement in useful life in steam generators firing corrosive coals. The magnesium zirconate ($MgZrO_3$) coating was resistant to corrosive attack, providing a self-healing mechanism by the formation of high-melting sulfates within its pores. This pore plugging effect withstood exposure cycles which would seriously damage conventional stainless steel tubes.

9117 **Waste heat power conversion system demonstration project at Easton, Maryland.** Judd, R.C. Washington, DC; Library, American Public Power Association (1980). 7p. (CONF-800264—3). $3.00.

From 24. American Public Power Association annual engineering and operations workshop; Phoenix, AZ, USA (25 Feb 1980).

The waste heat recovery system, its design and operation, and other efforts in energy conservation and efficiency are briefly reviewed. (MHR)

9118 **(AD-A—083481) Electrical equipment of electrical stations and substations.** Baptidanov, L.N.; Tarasov, V.I. (Foreign Technology Div., Wright-Patterson AFB, OH (USA)). 25 Oct 1979. Translation of Elektrooborudovaniye Elektricheskikh Stantsiy i Podstantsiy, Moscow-Leningrad, 1960 pp 6-408. 1548p. NTIS, PC A99/MF A01.

9119 **Investigation and repair of a steam accumulator failure.** Czernecki, R. (Toronto Hydro-Electric System, Ontario). pp 470-490 of Proceedings of the International District Heating Association. Volume 69. Pittsburgh, PA; International District Heating Association (1978).

From Meeting of the District Heating Association; Hot Springs, VA, USA (19 Jun 1978).

The Toronto Hydro-Electric Steam Plant, in Toronto, Canada, operated satisfactorily and without any abnormal occurrences for twelve years, when without any warning one of its three steam accumulators failed. Investigation of the failed accumulator determined that the failure was caused by corrosion fatigue of the metal of the shell and that thermal stratification of the water inside the vessel was the main cause. The investigation and examination of all three accumulators, the subsequent repair and modification of two of the vessels and the effects of this work, are discussed.

2002 Environmental Aspects

REFER ALSO TO CITATION(S) 9194, 9617, 9621, 9629, 9643, 9675, 9742, 9748

9120 **(BNL—51292) Regional Issue Identification and Assessment Program (RIIA). A methodology for analyzing the short-term air quality impacts of new power plants: issue paper 5.** Lipfert, F.W. (Brookhaven National Lab., Upton, NY (USA)). Jul 1979. Contract AC02-76CH00016. 27p. NTIS, PC A03/MF A01.

A simplified methodology is presented, based on Gaussian plume relationships, which could be used to assess regulatory constraints and vegetation damage for new power plants. Data input requirements include: (a) power plant size (MW), (b) fuel type, sulfur content, and level of control, and (c) nearby terrain elevation difference, with respect to stack base, for critical receptors. Based on sample calculations the 24-hour PSD increment is seen to be the most restrictive, using the ASME dispersion coefficients. An 800-MW plant (which is close to the optimum size from cost and reliability considerations according to a recent analysis), could be forced to reduce emissions below the levels assumed in this paper if adverse conditions were encountered. For example, terrain features higher than about 300 m at the critical distance from the plant could be restrictive, as could sufficiently persistent winds that would confine 24-hour plume spreading to $<10^{0}$.

9121 **(EPRI-CS—1608) Control of NO/sub x/ emissions at a 220-MW combined-cycle power plant. Final report.** Brechum, G.V.; Campobenedetto, E.J.; Anacki, D.W.; Langsjoen, P.L.; Muzio, L.J.; Thompson, R.E. (Babcock and Wilcox Co., Barberton, OH (USA); KVB, Inc., Irvine, CA (USA)). Nov 1980. 113p. NTIS, PC A06/MF A01.

The repowering of existing utility steam boilers with a combustion gas turbine to supply hot vitiated combustion air to the windbox of a fired boiler, in place of the normal forced draft fans and air preheaters, can lead to increased power output at improved heat rates. A major consideration in converting to combined cycle operation is the impact on the nitrogen oxides (NO/sub x/) emissions from the system. A field test program was conducted to determine the NO/sub x/ characteristics of a 220 MW supplementary fired unit. A primary objective was to determine the fraction of the gas turbine generated NO/sub x/ that can potentially be reduced upon passage through the combustion zone of the boiler. As part of this test program, the boiler was operated in a low NO/sub x/, staged combustion configuration by removing selected burners from service. The baseline NO/sub x/ emissions from the combined cycle system were found to be substantially lower than the NO/sub x/ emissions from the boiler alone when operated with ambient air supplied by forced draft fans, 1.4 lb NO_2/MW-hr compared to 2.3 lb NO_2/NW-hr at boiler loads of 190 MW and 200 MW respectively. In a staged combustion configuration with four of twenty burners removed from service, the combined cycle NO/sub x/ emissions were reduced to 0.9 lb NO_2/MW-hr. During normal operation of the combined cycle system with all burners in service, 10 to 28% of the NO/sub x/ produced by the gas turbine was reduced (destroyed) in the supplementary fired boiler. During operation of the boiler in a staged combustion configuration by removing four burners from service, a greater portion of the gas turbine generated NO/sub x/ was reduced in the boiler: 27% at a boiler load of 150 MW and 49% at a boiler load of 190 MW.

9122 **(EPRI-EA—1673-SY) Validation of plume models statistical methods and criteria.** Bowne, N.E. (TRC Environmental Consultants, Wethersfield, CT (USA)). Jan 1981. 37p. NTIS, PC A03/MF A01.

The Electric Power Research Institute has undertaken an experimental and analytical project designed to evaluate the performance of power plant plume models. A workshop was held to define the statistical methods and criteria proposed for model evaluation for this project. The workshop was principally concerned with the assessment of model performance in predicting ground-level concentrations, and the use of model predictions as a basis for regulatory decision-making. Characteristics of the concentration pattern of primary concern for validation are the magnitude and location of maximum concentration; the maximum concentration at a given distance; plume width and crosswind-integrated concentration at a given distance; and the correlation of predicted with observed point concentration values. Statistical methods have been specified appropriate for comparing simultaneous predicted and observed values of plume characteristics, for comparing the frequency distribution of predicted values with the distribution of observed values. These statistical methods require a data set reasonably free of temporal autocorrelation. Validation analyses should also include an investigation of data limitations, including measurement uncertainty and the estimation of plume characteristics from a finite grid of sampling points.

9123 **Multiobjective power plant siting methods.** Hobbs, B.F. (Cornell Univ., Ithaca, NY). *Journal of the Energy Division, ASCE (American Society of Civil Engineers) (U.S.);* **106**: No. 2, 187-200(Oct 1980).

The assumptions of three commonly applied siting methods are examined, and prescriptions for proper use given. Exclusionary screening presumes that exclusion criteria cannot be violated. Weighting summation, in contrast, allows tradeoffs to be made. Weight setting should be done carefully, however. Decision analysis considers attitudes towards risk, although probability distributions for siting attributes are rarely specified. Exclusionary screening and weighting summation choose different candidate areas for nuclear plants in two studies. Two weighting techniques also select different locations. One of the techniques, indifference tradeoff, guarantees valid weights, while the other, rating, does not. Site evaluations by decision analysis and weighting summation generally resemble each other closely, although in one study, the methods pick different sites as best. 35 refs.

9124 **Coal-ash agglomeration mechanism and its application in high temperature cyclones.** Jen, C.O.; Tsao, K.C. (Univ. of Wisconsin, Milwaukee). *Separation Science and Technology (U.S.);* **15**: No. 3, 263-276(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

The increase of particulate removal efficiency in a high-temperature cyclone is being examined analytically. A simple and effective approach is presented to view the coal-ash agglomeration phenomenon near its softening/fusion temperature. The probability of adhesion of the neighboring particles when coupled with the number of collisions of particles in a high-temperature cyclone appears to demonstrate that the high-temperature/pressure cyclone dust collector is capable of meeting the challenge of hot-gas cleanup problems. The effect of momentum of particles, surface tension, and viscosity of molten boundary layer enclosing a core particle is investigated for the enhancement of particle adhesion. Analytical computations and laboratory experience of a high-temperature cyclone are presented.

9125 **Problems and recent advances in aerosol filtration.** Loeffler, F. (Karlsruhe Univ., Germany). *Separation Science and Technology (U.S.);* **15**: No. 3, 297-315(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

Particles to be collected in fiber filters must be transported to the fiber surface and retained there. The collection efficiency phi can therefore be written as phi = eta h where eta is the collision efficiency, which describes the transport of particles to the fibers, and h is adhesion probability. The results of both theoretical and experimental studies of eta and h are presented. It is shown that electrostatic effects can have a major influence on collision efficiency.

9126 **Filtration of particulates and emulsions with a pleated, thin channel, cross-flow module.** Tanny, G.B.; Hauk, D. (Gelman Sciences Corp., Ann Arbor, MI). *Separation Science and Technology (U.S.);* **15**: No. 3, 317-337(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

The pleated, thin channel, crossflow module represents a novel flat sheet membrane configuration combining the modular advantages of hollow fiber design with the hydrodynamics of plate and frame units containing turbulence promoting elements. It consists of a circular array of parallel pleated thin channels, each of

whose inner wall is a membrane supported by a porous backing resting on a central product drain tube. The outer flexible wall is separated from the membrane by a turbulence promoting spacer and serves to create the flow channel, without fulfilling a direct filterative purpose. The design allows operation at elevated particulate levels and is highly suited to microfiltration of stray matter and bacteria from aqueous solutions to be injected into well heads for enhanced oil recovery. Data are presented for 0.45 and 0.2 μm pore size membrane modules containing 3.3 ft^2 of membrane area and operating on dispersions of standard particulates of known size distribution (80 μm to 0.2 μm). Effects of filtration mode (i.e., constant pressure or constant permeate rate), and crossflow velocity were examined at particulate concentrations from 250 to 800 ppM. For separation involving paraffinic oil/water emulsions, modules are either fabricated with ultrafiltration (UF) membrane, or a dynamically formed membrane is created on the microporous support.

2003 Power Transmission And Distribution

9127 **(AD-A—082734) Response of a terminated transmission line excited by a plane wave field for arbitrary angles of incidence.** Harrison, C.W. Jr.; Taylor, C.D. (Sandia Labs., Albuquerque, NM (USA)). Oct 1972. 12p. NTIS, PC A02/MF A01.

An analysis to determine the response of an impedance-loaded transmission line configuration excited by a plane-polarized electric field of arbitrary spatial orientation has been needed for a long time. The purpose of the present paper is to meet this need by suggesting a method of solution based on the analysis of the simplest of such circuits: an impedance - terminated two-conductor transmission line.

9128 **(AD-A—082759) Power controller 28Vdc load switching (N.O. SPST). Final report, 31 August 1977-21 January 1980.** McMackin, J.B. (RCA Government Communications Systems, Camden, NJ (USA)). 21 Jan 1980. Contract N62269-77-C-0413. 16p. NTIS, PC A02/MF A01.

A solid state power controller has been designed in four ratings to switch 28Vdc power to selected loads upon remote command. The four ratings trip out at currents of 10, 5, 2 and 1/2 amps. The design allows for wide variations in load and supply voltage and will not trip out on short load transients of up to 1000% of rated load current. In case of failure of the controller circuitry, an internal fuse protects the load from excessive current. The control current which operates the controller also provides a sensing function so that the state of the controller can be determined remotely. The controllers are designed to operate over a case temperature range of -54 C to 120 C. A quantity of 100 units have been fabricated, tested, and supplied to the Navy.

9129 **(EPRI-EL—1652) Development of an ionization-type gas density monitor. Final report.** Saaski, E.W. (Sigma Research, Inc., Richland, WA (USA)). Dec 1980. 41p. NTIS, PC A03/MF A01.

A battery-operated electronic gas density monitor has been developed for SF_6 service in gas-insulated substation equipment that is based on principles similar to ionization-type fire alarms. The monitor has a resolution of 0.1 psia at 68°F and exhibits a linearity of from +-0.15 to +-0.6 psia at 68°F over the pressure range 30 to 75 psia, depending on ion chamber characteristics and operating voltage. A prototype unit exhibited a deviation from ideality of about 0.01% per degree Fahrenheit over the temperature range -30° to 105°F and was found insensitive to water vapor in SF_6 at levels in excess of 1000 ppM.

9130 **(LA--8646-PR) LASL Nb_3Ge conductor development. Seventeenth quarterly progress report, July 1, 1980-September 30, 1980.** Thompson, J.D. (comp.). (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 9p. NTIS, PC A02/MF A01.

The seventeenth quarterly progress report of the Los Alamos Scientific Laboratory program to develop Nb_3Ge as a superconductor with potential applications to power transmission lines covers the period July 1 to September 30, 1980. During this quarter tests on our 1-m Nb_3Ge-based cable were performed at the Brookhaven National Laboratory (BNL). These tests consisted of measurement of ac loss as a function of 60 Hz current through the cable at various fixed temperatures between 7.5 and 14.5 K and of quench current as a function of temperature. Losses measured on the cable were high, ~ 1 mW/cm^2 at 500 rms A/cm, and comparable to losses in similar 1-m Nb_3Sn-based cables measured by BNL. Likewise, the quench current was unexpectedly low. We believe that these observations are not a result of the Nb_3Ge superconducting properties.

21 NUCLEAR POWER PLANTS

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 9145, 9147, 9165, 9166

9131 **(DOE/ET/34006—1) Extended burnup demonstration reactor fuel program. Semi-annual progress report, January 1979-September 1979.** Woods, K.N.; van Swam, L.F. (Consumers Power Co., Jackson, MI (USA); Exxon Nuclear Co., Inc., Richland, WA (USA); GPU Service Corp., Parsippany, NJ (USA)). 31 Dec 1980. Contract AC02-79ET34006. 54p. (XN-NF—80-25). NTIS, PC A04/MF A01.

This is the first semi-annual progress report for the DOE-sponsored Extended Burnup Demonstration program. The program objectives, description, and organization are detailed. Characteristics are given for the 64 Big Rock Point fuel rods and the four 8 x 8 Oyster Creek fuel assemblies which will be driven to extended burnup. The transfer of 64 Big Rock Point fuel rods from their original assemblies into host assemblies and the results of the fuel examination of these rods are described.

9132 **(DOE/ET/34006—2) Extended burnup demonstration reactor fuel program. Semiannual progress report, October 1979-March 1980. Report XN-NF-80-26.** Woods, K.N.; Van Swam, L.F. (Exxon Nuclear Co., Inc., Richland, WA (USA)). 31 Dec 1980. Contract AC0O2-79ET34006. 31p. NTIS, PC A03/MF A01.

The first of three scheduled poolside fuel examinations at the Oyster Creek reactor conducted during February/March 1980, was directed at one of the four symmetrically loaded ENC 8 x 8 lead assemblies that had achieved a burnup of ~ 25,000 MWd/MTU. Forty-five of the fuel rods in assembly UD3-109 were removed and examined. In general, the individual fuel rods were in excellent condition. The average fuel rod diameter continued to decrease during the last cycle was assembly burnup increased from 19,500 to 25,700 MWd/MTU. The creepdown since the beginning of life (BOL) in the center of the fuel rods is about 0.003 in. The fuel rods bore no indication of cladding ridging. Fuel rod growth continued at a linear rate of about 0.02% per GWd/MTU burnup since BOL. Preliminary eddy current test data showed that the cladding was free of significant defects. Visual examination of fuel rods, spacers, and tie plate revealed no unusual conditions. An average assembly burnup of 31,000 MWd/MTU is projected by the end of the next reactor cycle. Calculated plastic strain and internal rod pressure were shown to be within the design limit at that burnup. Licensing approval was obtained for the first extended burnup cycle. A cryogenically cooled germanium gamma scanning system for use at poolside was designed.

9133 (ORNL/RSIC—44, pp 107-120) **KENO calculations of light water fuel lattices.** Hebert, M.J. (Yankee Atomic Electric Co., Westboro, MA); Handschuh, J.A.; Pilat, E.E.; Edenius, M.; Harris, D.R.; Mayer, J.A. Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

At Yankee, KENO calculations of light water fuel lattices are being performed for the purpose of spent fuel rack design and as benchmarks for BWR bundle calculations. KENO calculations for BWR bundles are performed in order to verify the assumptions made in the more automated, integral transport theory calculation which is used for production purposes. Although this integral trans-

port code performs multi-group, space-dependent calculations of the bundle, a number of simplifying assumptions are necessary because of the extreme heterogeneity of the bundle. Such assumptions relate to the self-shielding of the gadolinia burnable poison present in selected fuel -rods, to the definition of unit cells (the 2D transport calculation is performed on a unit cell basis), and to the representation of the boron carbide filled steel tubes which comprise the control rod, as well as to the perturbing effects of non-identical neighboring bundles.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

9134 (ORNL/RSIC—44, pp 151-156) **Radiation streaming with SAM-CE.** De Gangi, N.; Cohen, M.O.; Waluschka, E.; Steinberg, H.A. (Mathematical Applications Group, Inc., Elmsford, NY). Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

The SAM-CE Monte Carlo code has been employed to calculate doses, due to neutron streaming, on the operating floor and other locations of the Millstone Unit II Nuclear Power Facility. Calculated results were compared against measured doses.

9135 (ORNL/RSIC—44, pp 197-202) **Analysis of excore detector response to core water level using Monte Carlo techniques.** Lucier, R.D. (Yankee Atomic Electric Co., Westboro, MA); Cacciapouti, R.J.; Harris, D.R.; Napolitano, D. Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

In response to US Nuclear Regulatory Commission requirements, each commercial reactor must have a method of indicating core water level. This paper presents a calculation of excore neutron detector response using Monte Carlo techniques to determine core water level. An increase in excore detector response of a factor of about 3 has ben calculated for a half voided core. Using this approach the operating staff at a Nuclear Power Station can determine core water level in the event of an incident causing voids in the primary loop.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 8638, 9146, 9161, 9162, 9432

9136 **(GA-A—15612) Pre- and postirradiation evaluation of TRISO ThO_2 particles irradiated in capsule HT-34.** Young, C.A.; Jones, C.S. (General Atomic Co., San Diego, CA (USA)). Oct 1980. Contract AT03-76ET35300. 148p. NTIS, PC A07/MF A01.

Capsule HT-34 was irradiated jointly by General Atomic Company (GA) and Oak Ridge National Laboratory (ORNL). This report presents the pre- and postirradiation evaluation conducted by GA. The purpose of the test was to characterize the mechanical and chemical performance and fission product release of TRISO ThO_2 particles. Sixteen TRISO ThO_2 samples, which had been fabricated in the production-line (240-mm-ID) coater, were irradiated at approximately 1200 and 1450°C to neutron fluences of 5.1 to 10.2 x 10^{25} n/m² (E > 29 fJ)/sub HTGR/, and burnups of 5.1 to 12.7% FIMA. Following are the results of the postirradiation examination: the OPyC coating failure of the 800-μm-diameter particles irradiated at 1200°C was ≦ 1.8%; the pressure-vessel model overpredicted failure up to seven times the observed failure for the samples irradiated at 1200°C; palladium attack and internal corrosion of the SiC coating was observed in the samples irradiated at 1200°C; internal corrosion of the SiC coating caused SiC failure up to 100% in the samples irradiated at 1450°C; and an average of 16 and 90% of the Cs was released from failed particles irradiated at 1200 and 1450°C, respectively, after 2686 h of irradiation.

9137 **(ORNL—5694) Comparative evaluation of pebble-bed and prismatic fueled high-temperature gas-cooled reactors.** Kasten, P.R.; Bartine, D.E. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 223p. NTIS, PC A10/MF A01.

A comparative evaluation has been performed of the HTGR and the Federal Republic of Germany's Pebble Bed Reactor (PBR) for potential commercial applications in the US. The evaluation considered two reactor sizes [1000 and 3000 MW(t)] and three process applications (steam cycle, direct cycle, and process heat, with outlet coolant temperatures of 750, 850, and 950°C, respectively). The primary criterion for the comparison was the levelized (15-year) cost of producing electricity or process heat. Emphasis was placed on the cost impact of differences between the prismatic-type HTGR core, which requires periodic refuelings during reactor shutdowns, and the pebble bed PBR core, which is refueled continuously during reactor operations. Detailed studies of key technical issues using reference HTGR and PBR designs revealed that two cost components contributing to the levelized power costs are higher for the PBR: capital costs and operation and maintenance costs. A third cost component, associated with nonavailability penalties, tended to be higher for the PBR except for the process heat application, for which there is a large uncertainty in the HTGR nonavailability penalty at the 950°C outlet coolant temperature. A fourth cost component, fuel cycle costs, is lower for the PBR, but not sufficiently lower to offset the capital cost component. Thus the HTGR appears to be slightly superior to the PBR in economic performance. Because of the advanced development of the HTGR concept, large HTGRs could also be commercialized in the US with lower R & D costs and shorter lead times than could large PBRs. It is recommended that the US gas-cooled thermal reactor program continue giving primary support to the HTGR, while also maintaining its cooperative PBR program with FRG.

2105 Power Reactors, Breeding

9138 **(ANL—76-128) Postirradiation examinations of element G-3 from the GCFR F-1 series of mixed-oxide elements after approx. 3 at. % burnup.** Strain, R.V. (Argonne National Lab., IL (USA)). Sep 1980. Contract W-31-109-ENG-38. 42p. NTIS, PC A03/MF A01.

Postirradiation examinations were performed on element G-3, from the GCFR F-1 series of mixed-oxide elements, after 2.6 at. % burnup in EBR-II. The 20% cold-worked Type 316 stainless steel clad G-3 element was irradiated as an encapsulated element using a stainless steel thermal barrier to achieve peak cladding temperatures of 690°C at a peak power of 14.4 kW/ft. The maximum diametral increase of the element was 0.2% $\Delta D/D_0$. The volatile fission products were found just above the top of the fuel column and in a gap between the bottom and next higher fuel pellet. Annular pellets were used in the element, and at 2.6 at. % burnup, the central hole was closed by fuel material at both the top and the bottom of the fuel column. Fission-product attack of the cladding was minimal; a uniform matrix attack of only 0.3 mil was found along most of the length of the fuel column.

9139 **(DOE/ET/37240—76) Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, March 1, 1980-May 31, 1980.** Todreas, N.E.; Golay, M.W.; Wolf, L. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1980. Contract AS02-76ET37240. 65p. NTIS, PC A04/MF A01.

Experimental and theoretical work is reported on four tasks: bundle geometry (wrapped and bare rods), subchannel geometry (bare rods), LMFBR outlet plenum flow mixing, and theoretical local temperature files in LMFBR fuel rod bundles. (DLC)

9140 **(DOE/ET/37240—77TR) Laboratory manual for static pressure drop experiments in LMFBR wire wrapped rod bundles.** Burns, K.J.; Todreas, N.E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Jul 1980. Contract AS02-76ET37240. 74p. NTIS, PC A04/MF A01.

Purpose of this experiment is to determine both interior and edge subchannel axial pressure drops for a range of Reynolds num-

bers. The subchannel static pressure drop is used to calculate subchannel and bundle average friction factors, which can be used to verify existing friction factor correlations. The correlations for subchannel friction factors are used as input to computer codes which solve the coupled energy, continuity, and momentum equations, and are also used to develop flow split correlations which are needed as input to codes which solve only the energy equation. The bundle average friction factor is used to calculate the overall bundle pressure drop, which determines the required pumping power.

9141 **(ENICO—1065) Correlation of ^{235}U thermal and fast reactor fission yields with neutron energy.** Maeck, W.J. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Dec 1980. Contract AC07-79ID01675. 80p. NTIS, PC A05/MF A01.

The relative isotopic abundances and the fission yields for over 40 stable and long-lived fission products from ^{235}U fast fission correlate well with neutron energy. Only mass spectrometric data were used in this study. For many nuclides, changes of only a few percent in the relative isotopic abundance or the fission yields over the energy range of thermal to 1 MeV are easily discernable and significant. The neutron energy index used in this study is the $^{150}Nd/^{143}Nd$ isotopic ratio. The results of this correlation study are compared to the US Evaluated Nuclear Data File (ENDF) fast fission yield compilation. Specific discrepancies are noted.

9142 **(WAPD-MRP—154) Shippingport Atomic Power Station (PWR). Technical progress report, January 26, 1980-July 25, 1980.** (Bettis Atomic Power Lab., West Mifflin, PA (USA)). 1980. Contract AC11-76PN00014. 37p. NTIS, PC A03/MF A01.

The Shippingport Atomic Power Station was operated with the Light Water Breeder Reactor (LWBR) core primarily at high power levels (base load) until February 29, 1980, when a planned semiannual shutdown for maintenance and testing began. The design objective of 15,000 equivalent full power hours of operation was achieved on February 24, 1980. Power operation was resumed on April 19, 1980, and continued through the end of the report period, accumulating 17,190 EFPH on July 25, 1980, except for reductions in power or brief shutdowns to perform planned testing, swing load operations, and maintenance. The periodic flow coefficient of reactivity measurements continued to meet the criteria on which the revised core protection setpoints and station operating procedures (see WAPD-MRP-152) were based. The program of load swings to demonstrate load follow capability was continued during this period with the performance of an additional 49 swing loads for a total of 203 load swings since initial operation.

9143 **(WAPD-TM—1255) Study of the compaction parameters affecting cracks in high density thorium oxide fuel pellets (LWBR development program).** Burke, T.J.; Myers, C.J.; Swanson, R.E. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Sep 1980. Contract AC11-76PN00014. 99p. NTIS, PC A05/MF A01.

This investigation characterizes the double action compaction process through a study of the punch force and press motions involved in the operation of a Dorst model mechanical compacting press. Thorium oxide pellets were pressed with length-to-diameter ratios ranging from 0.25 to 1.95 and green densities of 55 to 64% theoretical density to identify controlling press parameters affecting crack type defects in the sintered high density pellet structure. Edge cracking was determined to be a compaction induced defect resulting from overpressing at the top of the pellet. Reduction in edge cracking without sacrificing geometric green density was achieved by control of the pellet axial density gradient.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

9144 **(LA-UR—80-3592) Space nuclear power: a strategy for tomorrow.** Buden, D.; Angelo, J. Jr. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 12p. (CONF-810205—1). NTIS, PC A02/MF A01.

From American Institute of Aeronautics and Astronautics conference on large space platforms; San Diego, CA, USA (2 Feb 1981).

Energy: reliable, portable, abundant and low cost will be a most critical factor, perhaps the sine qua non, for the unfolding of man's permanent presence in space. Space-based nuclear power, in turn, is a key technology for developing such space platforms and the transportation systems necessary to service them. A strategy for meeting space power requirements is the development of a 100-kW(e) nuclear reactor system for high earth orbit missions, transportation from Shuttle orbits to geosynchronous orbit, and for outer planet exploration. The component technology for this nuclear power plant is now underway at the Los Alamos National Laboratory. As permanent settlements are established on the Moon and in space, multimegawatt power plants will be needed. This would involve different technology similar to terrestrial nuclear power plants.

2108 Economics

REFER ALSO TO CITATION(S) 8684, 9199

9145 **(COO—34012-2) Uranium utilization experience in light water reactors. Historical data through April 30, 1980.** Brittelli, R. Jr. (Nuclear Assurance Corp., Atlanta, GA (USA)). Sep 1980. Contract AC02-79ET34012. 102p. (NAC-C—8024). NTIS, PC A06/MF A01.

This analysis discusses the historical experience of operating light water reactors with respect to achieved uranium utilization rates. The data is presented graphically and tabularly. Historical specific energies have been determined for all operating cycles for each nuclear reactor having completed at least one cycle prior to April 1980. In addition, the data has been aggregated to illustrate the following: performance of BWRs and PWRs; reactors with a MWe rating above and below 800 MWe; reactors which have operated for five cycles or more; and chronological experience of annual discharges. 27 figures.

9146 **(GA-A—15748) Preliminary plan for the qualification of the LEU/Th fuel cycle for the Fort St. Vrain HTGR.** Gulden, T.D.; Gainey, B.W.; Altschwager, C.J. (comps.). (General Atomic Co., San Diego, CA (USA)). Mar 1980. Contract AC03-79SF10748. 103p. NTIS, PC A06/MF A01.

This plan was prepared to ensure that low-enriched uranium/thorium (LEU/Th) would be available as a backup to the highly enriched uranium/thorium (HEU/Th) fuel cycle currently being used in the Fort St. Vrain (FSV) high-temperature gas-cooled reactor (HTGR) in the event that the US nonproliferation policies require it. It describes the program that would be required to develop, qualify, and introduce an LEU/Th fuel cycle into the FSV HTGR on the earliest possible and most optimistic schedule. The results of the study indicate that licensing of the LEU/Th fuel cycle for FSV could be completed and fuel manufacturing could begin about 4.5 years from inception of the program.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

9147 (ORNL/RSIC—44, pp 129-136) **Geometry modeling for SAM-CE Monte Carlo calculations.** Steinberg, H.A.; Troubetzkoy, E.S. (Mathematical Applications Group, Inc., Elmsford, NY). Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

Three geometry packages have been developed and incorporated into SAM-CE, for representing in three dimensions the transport medium. These are combinatorial geometry - a general (non-lattice) system, complex combinatorial geometry - a very general system with lattice capability, and special reactor geometry - a special purpose system for light water reactor geometries. Their different attributes are described.

9148 (ORNL/RSIC—44, pp 137-142) **Nuclear data treatment for SAM-CE Monte Carlo calculations.** Lichtenstein, H.; Troubetzkoy, E.S.; Beer, M. (Mathematical Applications Group, Inc., Elmsford, NY). Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

The treatment of nuclear data by the SAM-CE Monte Carlo code system is presented. The retrieval of neutron, gamma production, and photon data from the ENDF/B fils is described. Integral cross sections as well as differential data are utilized in the Monte Carlo calculations, and the processing procedures for the requisite data are summarized.

9149 (ORNL/RSIC—44, pp 143-150) **Monte Carlo methodology as implemented in SAM-F.** Troubetzkoy, E.S.; Steinberg, H.A. (Mathematical Applications Group, Inc., Elmsford, NY). Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

The variance reduction techniques implemented in SAM-F are discussed. This includes importance sampling as a function of position, direction, energy and time, and judicious use of quota sampling.

9150 (ORNL/RSIC—44, pp 157-168) **TRX and UO2 criticality benchmarks with SAM-CE.** Beer, M. (Mathematical Applications Group, Inc., Elmsford, NY); Troubetzkoy, E.S.; Lichtenstein, H.; Rose, P.F. Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

A set of thermal reactor benchmark calculations with SAM-CE which have been conducted at both MAGI and at BNL are described. Their purpose was both validation of the SAM-CE reactor eigenvalue capability developed by MAGI and a substantial contribution to the data testing of both ENDF/B-IV and ENDF/B-V libraries. This experience also resulted in increased calculational efficiency of the code and an example is given. The benchmark analysis included the TRX-1 infinite cell using both ENDF/B-IV and ENDF/B-V cross section sets and calculations using ENDF/B-IV of the TRX-1 full core and TRX-2 cell. BAPL-UO2-1 calculations were conducted for the cell using both ENDF/B-IV and ENDF/B-V and for the full core with ENDF/B-V.

2202 Components And Accessories

9151 **(BNL—28664) Conduction cooling: multicrate fastbus hardware.** Makowiecki, D.; Sims, W.; Larsen, R. (Yale Univ., New Haven, CT (USA); Brookhaven National Lab., Upton, NY (USA); Academia Sinica, Bejing (China)). Nov 1980. Contract AC02-76CH00016. 13p. (CONF-801103—48). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

Described is a new and novel approach for cooling nuclear instrumentation modules via heat conduction. The simplicity of liquid cooled crates and ease of thermal management with conduction cooled modules are described. While this system was developed primarily for the higher power levels expected with Fastbus electronics, it has many general applications.

9152 **(PNL-SA—8090) Non-destructive examination and component reliability: what should we be looking for.** Bush, S.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract AC06-76RL01830. 18p. (CONF-800231—3). NTIS, PC A02/MF A01.

From 3. international conference on nondestructive evaluation in the nuclear industry; Salt Lake City, UT, USA (11 Feb 1980).

Causes of crack initiation and propagation leading to leaking or to component failure have been examined for various pressure boundary components in nuclear systems. These failures have been reviewed as to their safety significance. Such failures were predominantly due to intergranular stress corrosion, thermal fatigue and erosion fatigue in the component population examined. Based on the success or lack of success in detecting cracks due to these predominant mechanisms suggestions are made concerning use of more information in the UT frequency spectrum. Alternately, the amplitude approach should be optimized to improve the probability of detection of flaws such as IGSCC.

9153 **Two-fluid model of two-phase flow in a pin bundle of a nuclear reactor.** Chawla, T.C.; Ishii, M. (Argonne National Lab., IL (USA)). *International Journal of Heat and Mass Transfer (England);* **23**: No. 7, 991-1001(Jul 1980).

By considering two-phase flow as a field which is subdivided into two turbulent single-phase regions with moving boundaries separating the two constituent phases, such that the differential balances for three-dimensional turbulent flow hold for each subregion and for the interface, we perform the Eulerian area averaging over the cross-sectional area of each phase in a given channel and segment averaging of transverse momentum equation along the phase intercepts at the interchannel boundaries. To simplify the governing equations obtained as a result of these operations, we invoke the assumption that the motion of the fluid in each phase is dominantly in axial direction, that is the transverse components of velocity are small compared to axial components. We further assume that the variation of axial component of velocity within a channel is much stronger than the variation along the axial direction. We also assume that similar arguments can also be applied to the variation of enthalpy in a channel. As a result of these considerations, we obtain two sets of continuity, momentum, and energy equations describing motion of each phase in the axial direction. The phasic interaction terms which appear in these equations are governed by interfacial transfer conditions obtained from interface balances. The segment-averaged transverse-momentum equation for each phase provides the governing equation for cross flow.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 8639

2204 Control Systems

9154 **(UCID—18950) Proposed design modifications and technical specification changes on grid voltage degradation for the Point Beach Nuclear Plant, Units 1 and 2 (Docket Nos. 50-266 and 50-301). Technical evaluation report.** White, R.L. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Jan 1981. Contract W-7405-ENG-48. 14p. NTIS, PC A02/MF A01.

This report documents the technical evaluation of the proposed design mofifications and Technical Specification changes for protection of Class 1E equipment from grid voltage degradation for the Point Beach Nuclear Plant, Units 1 and 2. The review criteria are based on several IEEE standards and the Code of Federal Regulations. The evaluation compares the submittals made by the licensee with the NRC staff positions and the review criteria and presents the reviewer's conclusion on the acceptability of the proposed system.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 9741

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 8682, 8683, 9169, 9948, 9953

9155 **(LA—8638-SR) Nuclear data development work in support of the National Bureau of Standards ISNF Project. Status report, February 1976-July 1980.** LaBauve, R.J.; George, D.C.; Muir, D.W.; Soran, P.D.; Eisenhauer, C.M. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 21p. NTIS, PC A02/MF A01.

Work in several areas was completed by the Los Alamos Scientific Laboratory for the National Bureau of Standards in connection with the Intermediate-Energy Standard Neutron Field (ISNF) project during this reporting period. These areas include supplying multigroup cross section sets from ENDF/B-IV appro-

priate for ISNF calculations; determining the effects of small changes in calculational parameters, including cross section changes, in LSNF results; providing additional selected multigroup cross section sets from both ENDF/B-IV and ENDF/B-V; and performing comparison ISNF calculations using discrete ordinates and Monte Carlo codes. Plans for future work are briefly mentioned. 12 figures, 5 tables.

9156 (ORNL/RSIC—44, pp 31-46) **VIM: a continuous energy Monte Carlo code at ANL.** Blomquist, R.N.; Lell, R.M.; Gelbard, E.M. (Argonne National Lab., IL). Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

The continuous-energy Monte Carlo neutron transport code VIM and its auxiliaries are briefly described. The ENDF/B cross section data processing procedure is summarized and its benchmarking against MC^2-2 is reviewed. Several representative applications at ANL are described, including fast critical assembly benchmark calculations and STF and TREAT Upgrade benchmark calculations. 2 figures.

9157 **(UVA—527230/NEEP80/101) Participation in the United States Department of Energy reactor sharing program. Final report, September 1978-August 1980.** Shriver, B.L.; Benneche, P.E. (Virginia Univ., Charlottesville (USA). Research Labs. for the Engineering Sciences). Aug 1980. Contract FG05-780RO6080. 30p. NTIS, PC A03/MF A01.

The University of Virginia Research Reactor is the highest power (2 MW(t)) and most utilized (4400 MWh in 1979) research reactor in the mid-Atlantic States. A second, small (100 W) reactor is also available. This report documents the major educational accomplishments of the University of Virginia Reactor Facility under the Reactor Sharing Program. (DLC)

2209 Reactor Safety

9158 **(DOE/EV/10278—T1) Crisis contained, The Department of Energy at Three Mile Island: a history.** Cantelon, P.L.; Williams, R.C. (C and W Associates, Westmoreland, NH (USA)). Dec 1980. Contract AC02-79EV10278. 243p. NTIS, PC A11/MF A01.

An account is given of the response of US DOE to the Three Mile Island-2 accident on March 28, 1979. The accident is treated as though it was a military battle. A synoptic chronologgy of the accident events and of DOE and other responses is included. (DLC)

9159 **(DOE/SF/10754—T1) Nuclear safety code study.** Hu, H.H.; Ford, D.; Le, H.; Park, S.; Cooke, K.L.; Bleakney, T.; Spanier, J.; Wilburn, N.P.; O'Reilly, B.; Carmichael, B. (Claremont Graduate School, CA (USA). Dept. of Mathematics). Jan 1981. Contract FG03-79SF10754. 40p. NTIS, PC A03/MF A01.

The objective is to analyze an overpower accident in an LMFBR. A simplified model of the primary coolant loop was developed in order to understand the instabilities encountered with the MELT III and SAS codes. The computer programs were translated for switching to the IBM 4331. Numerical methods were investigated for solving the neutron kinetics equations; the Adams and Gear methods were compared. (DLC)

9160 **(EPRI-NP—1609) Transport of fuel and fission products from failed mixed-oxide fuel pins by flowing sodium in LMFBRs. Final report.** Tetenbaum, M. (Argonne National Lab., IL (USA)). Nov 1980. Contract W-31-109-ENG-38. 81p. NTIS, PC A05/MF A01.

A review was made of what is known about transport of fuel particles and fission products from LMFBR failed fuel pins and deposit of these radioactive materials in the primary coolant system. Such transport and deposit could significantly increase exposure of plant personnel and become limiting in operability, inspectability, and maintainability of piping and equipment in primary coolant cells. Any direct access will require waiting about 12 days after reactor shutdown, and the sodium must be drained from the system to a shielded tank. Plateout of active materials and coolant films remaining on surfaces after draining are the sources causing concern. 25 tables.

9161 **(GA-A—16017) Venting characteristics of a fibrous thermal barrier system during a rapid depressurization accident (rotor failure) in an HTGR-GT.** Lightner, S.; Betts, W.S. Jr. (General Atomic Co., San Diego, CA (USA)). Nov 1980. Contract AT03-76SF70046. 8p. (CONF-810309—2). NTIS, PC A02/MF A01.

From ASME gas turbine conference; Houston, TX, USA (9 Mar 1981).

The thermal barrier inside the primary circuit of the direct-cycle, high-temperature gas-cooled reactor-gas turbine (HTGR-GT) may experience rapid depressurization transients. Turbine rotor failure induces the most severe pressure transient. To determine how rotor failure affects the design adequacy of the thermal barrier, the authors experimentally examined the venting characteristics of the fibrous insulation. This paper theoretically develops a simulation technique and correlates the analytical results with test data.

9162 **(GA-A—16027) HTGR-GT primary coolant transient resulting from postulated turbine deblading.** Cadwallader, G.J.; Deremer, R.K. (General Atomic Co., San Diego, CA (USA)). Nov 1980. Contract AT03-76SF70046. 11p. (CONF-810309—3). NTIS, PC A02/MF A01.

From ASME gas turbine conference; Houston, TX, USA (9 Mar 1981).

The turbomachine is located within the primary coolant system of a nuclear closed cycle gas turbine plant (HTGR-GT). The deblading of the turbine can cause a rapid pressure equilibration transient that generates significant loads on other components in the system. Prediction of and design for this transient are important aspects of assuring the safety of the HTGR-GT. This paper describes the adaptation and use of the RATSAM program to analyze the rapid fluid transient throughout the primary coolant system during a spectrum of turbine deblading events. Included are discussions of (1) specific modifications and improvements to the basic RATSAM program, which is also briefly described; (2) typical results showing the expansion wave moving upstream from the debladed turbine through the primary coolant system; and (3) the effect on the transient results of different plenum volumes, flow resistances, times to deblade, and geometries that can choke the flow.

9163 **(PNL-SA—8691) Acoustic emission. Flaw relationship for in-service monitoring of nuclear pressure vessels.** Hutton, P.H.; Kurtz, R.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1980. Contract AC06-76RL01830. 8p. (CONF-8006142—1). NTIS, PC A02/MF A01.

From ACRS metal component subcommittee for reactor safety meeting; Washington, DC, USA (17 Jun 1980).

Acoustic emission (AE) testing has the potential of being a valuable NDI method with capability for continuous monitoring, high sensitivity, and remote flaw location. Tests of the method were carried out on ASTM A533 Grade B, Class 1 steel. Crack growth AE signals could be recognized. An AE/fracture mechanics relation was developed for flaw interpretation. Two intermediate vessel tests at ORNL under the HSST program were analyzed. A simulated reactor vessel test and installation of an AE sensing system on a reactor are planned. (DLC)

9164 **(SAND—80-2491) Light Water Reactor Safety Technology Program. Quarterly report V, April-June 1980.** (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 65p. NTIS, PC A04/MF A01.

Areas of activity during the last quarter are reported and have been broadly categorized as follows: management support program, risk methods utilization, improved safety systems, man-machine interface, and safety data.

9165 **(UCID—18698(Vol.1)) Systematic evaluation program review of NRC Safety Topic VI-7.3 associated with the electrical, instrumentation and control portions of the ECCS actuation system for the Dresden II Nuclear Power Plant.** St. Leger-Barter, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1980. Contract W-7405-ENG-48. 25p. NTIS, PC A02/MF A01.

This report documents the technical evaluation and review of NRC Safety Topic VI-7.A.3, associated with the electrical, instrumentation, and control portions of the classification of the ECCS actuation system for the Dresden II nuclear power plant, using current licensing criteria.

9166 **(UCID—18698(Vol.2)) Systematic evaluation program review of NRC Safety Topic VI-10.A associated with the electrical, instrumentation and control portions of the testing of reactor trip system and engineered safety features, including response time for the Dresden station, Unit II nuclear power plant.** St. Leger-Barter, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1980. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01.

This report documents the technical evaluation and review of NRC Safety Topic VI-10.A, associated with the electrical, instrumentation, and control portions of the testing of reactor trip systems and engineered safety features including response time for the Dresden II nuclear power plant, using current licensing criteria.

9167 **(UCRL—53001) Seismic Safety Margins Research Program. Phase I. Interim definition of terms.** Smith, P.D.; Dong, R.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Dec 1980. Contract W-7405-ENG-48. 21p. NTIS, PC A02/MF A01.

This report documents interim definitions of terms in the Seismic Safety Margins Research Program (SSMRP). Intent is to establish a common-based terminology integral to the probabilistic methods that predict more realistically the behavior of nuclear power plants during an earthquake. These definitions are a response to a request by the Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards at its meeting held November 15-16, 1979.

9168 **(UCRL—84157) Usng subjective percentiles and test data for estimating fragility functions.** George, L.L.; Mensing, R.W. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 15 Jan 1981. Contract W-7405-ENG-48. 26p. (CONF-801045—7). NTIS, PC A03/MF A01.

From DOE statistical symposium; Berkeley, CA, USA (29 Oct 1980).

Fragility functions are cumulative distribution functions (cdfs) of strengths at failure. They are needed for reliability analyses of systems such as power generation and transmission systems. Subjective opinions supplement sparse test data for estimating fragility functions. Often the opinions are opinions on the percentiles of the fragility function. Subjective percentiles are likely to be less biased than opinions on parameters of cdfs. Solutions to several problems in the estimation of fragility functions are found for subjective percentiles and test data. How subjective percentiles should be used to estimate subjective fragility functions, how subjective percentiles should be combined with test data, how fragility functions for several failure modes should be combined into a composite fragility function, and how inherent randomness and uncertainty due to lack of knowledge should be represented are considered. Subjective percentiles are treated as independent estimates of percentiles. The following are derived: least-squares parameter estimators for normal and lognormal cdfs, based on subjective percentiles (the method is applicable to any invertible cdf); a composite fragility function for combining several failure modes; estimators of variation within and between groups of experts for nonidentically distributed subjective percentiles; weighted least-squares estimators when subjective percentiles have higher variation at higher percents; and weighted least-squares and Bayes parameter estimators based on combining subjective percentiles and test data. 4 figures, 2 tables.

9169 **(LA—6206(Vol.2)(Add)(Rev.1)) Safety analysis of the Los Alamos critical experiments facility: burst operation of Skua.** Orndoff, J.D.; Paxton, H.C.; Wimett, T.F. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 22p. NTIS, PC A02/MF A01.

Detailed consideration of the Skua burst assembly is provided, thereby supplementing the facility Safety Analysis Report covering the operation of other critical assemblies at the Los Alamos Scientific Laboratory. As with these assemblies the small fission-product inventory, ambient pressure, and moderate temperatures in Skua are amenable to straightforward measures to ensure the protection of the public.

9170 **Core thermal-hydraulic response during the loca and steam generator tube rupture.** Wang, H.T. *Ho Tzu K'o Hsueh (Taiwan);* **16**: No. 1, 16-23(Mar 1979). (In Chinese and English).

Twelve simulated PWR (pressurized water reactor) tests were conducted under the LOCA (loss-of-coolant-accident) followed by the steam generator tube rupture. The peak core temperature of each test was listed and the maximum peak core temperature (985°C) among the twelve tests occurred between the 14 and 16 ruptured tubes. Three types of quenching phenomena were identified, the top, top-bottom and bottom quenches. The top and bottom quenches were caused by the injections of the ruptured feedwater from the secondary system entering the top of the core and the cold leg ECCS (emergency core coolant system) entering the bottom of the core, respectively. The top-bottom quench was caused by the two injections.

25 ENERGY STORAGE

2503 Pumped Hydro

9171 **(ANL/ES—101) Evaluation of advanced hydraulic turbomachinery for underground pumped hydroelectric storage. Part 2. Two-stage regulated pump/turbines for operating heads of 1000 to 1500 m.** Blomquist, C.A.; Frigo, A.A.; Degnan, J.R. (Argonne National Lab., IL (USA)). Oct 1979. Contract W-31-109-ENG-38. 120p. NTIS, PC A06/MF A01.

This UPHS report applies to Francis-type, reversible pump/turbines regulated with gating systems. The first report, however, covered single-stage regulations; this report covers two-stage regulations. Development of a two-stage regulated pump/turbine appears to be attractive because the proposed single-drop UPHS concept requires turbomachinery with a head range of 1000 to 2000 m. With turbomachinery of this range available, the single-drop scheme offers a simple and economic UPHS option. Six different two-stage, top-gated pump/turbines have been analyzed: three that generate 500 MW and three that generate 350 MW. In each capacity, one machine has an operating head of 1000 m, another has a head of 1250 m, and the third has a head of 1500 m. The rated efficiencies of the machines vary from about 90% (1000-m head) to about 88% (1500-m head). Costs in 1978 $/kW for the three 500-MW units are: 20.5 (1000 m), 16.5 (1250 m), and 13.5 (1500 m). Corresponding costs for the three 350-MW units are 23, 18, and 14 $/kW. No major turbomachinery obstacles are foreseen that could hamper development of these pump/turbines. Further model testing and development are needed before building them.

9172 **(ANL/ES—106) Study of certain economic aspects of turbomachinery for underground pumped hydroelectric storage plants.** Tam, S.W.; Clinch, J.M. (Argonne National Lab., IL (USA)). Dec 1979. Contract W-31-109-ENG-38. 36p. NTIS, PC A03/MF A01.

The economics of underground pumped hydroelectric storage (UPHS) were analyzed in two ways. First, the cost effects of a variety of machinery-related factors on a UPHS plant were estimated. Second, four actual turbomachinery options were evaluated in terms of those factors. Preliminary conclusions about UPHS costs are as follows: the use of advanced turbomachinery is more economical than the use of state-of-art turbomachinery; plant-construction cost and the cost of the turbomachinery itself decrease as the operating head increases (The lowest costs now occur at a head

range of 1200 to 1500 m for a UPHS plant designed on the single-drop principle. A machine's high charge/discharge ratio also lowers construction cost.); and pump/turbine efficiencies and charge/discharge ratios represent very important design parameters for UPHS applications. One of the advanced options considered, a two-stage reversible pump/turbine engineered for Argonne by the Allis-Chalmers Hydro-Turbine Division, appears to have the most cost-effective design for high-head applications (1000 to 2000 m). Further development of the two-stage concept promises future heads greater than 1500 m.

2505 Flywheels

9173 (AD-A—083302) High energy storage flywheel test program. Final report. Hodson, D.R. (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.). 28 Jan 1980. Contract DAAG53-75-C-0278. 146p. NTIS PC MF A01.

The RS-31 Flywheel System is an energy storage device which is accelerated by an AVCO LYCOMING T55-L-7C 2930 SHP drive engine to 14,506 RPM. The two contra-rotating double disk rotors of the flywheel module have an inertia of 320,176 sq. in.-lbs storing 30 KW-HRS of energy at design speed. This was a Research and Development test activity designed to explore and verify design predictions of system performance.

2506 Thermal

REFER ALSO TO CITATION(S) 9056, 9058, 9059, 9060, 9061, 9062

2509 Batteries

REFER ALSO TO CITATION(S) 8830, 8831, 9055

9174 (AD-A—082515) Comparison of on-board aircraft NiCad battery chargers. Report for June 1978-May 1979. Dickinson, J.D. (Army Aviation Research and Development Command, St. Louis, MO (USA)). Jan 1980. 95p. NTIS, PC A05/MF A01.

A test was conducted at the Applied Technology Laboratory at Fort Eustis, Virginia to establish the performance characteristics of several on-board aircraft NiCad battery chargers. The test assessed performance characteristics of chargers from Utah Research and Development Company, Aerospace Avionics Corp., Eldec Corp., and Chrysler Corp. These performance characteristics were also compared to the battery performance associated with a simulated aircraft bus charging source. Adjunct tests investigated battery maintenance procedures.

9175 (AD-A—083434) Evaluation of low melting halide systems for battery applications. Interim report, 1 September 1978-31 August 1979. Mamantov, G. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). Nov 1979. Contract F33615-78-C-2075. 46p. NTIS, PC A03/MF A01.

This three year program involves evaluation of selected low temperature molten salt solvent systems containing inorganic and/or organic chlorides and bromides for battery applications. The research involves determination of the liquidus temperatures, the specific electrical conductivity, and the electrochemical span of selected halide systems. Characterization of the solvent species by Raman spectroscopy, vapor pressure measurements, and the electrochemical study of a few cathode and anode systems will be undertaken for the most promising solvent systems.

9176 (AD-A—084907) Phase meter measurement of state of charge for satellite NiCd cells: a preliminary study. Interim report. Martinelli, M.R.; Mayer, S.W.; Badcock, C.C. (Aerospace Corp., El Segundo, CA (USA). Chemistry and Physics Lab.). 30 Aug 1979. Contract F04701-78-C-0079. 31p. NTIS, PC A03/MF A01.

Experiments were performed to determine if the phase angle between alternating voltage and current could be used to predict, within a probable error of 5%, the state of charge of seven individual sealed (General Electric) model 10AB08 NiCd) cells and a battery consisting of the seven cells in series. The cells were charged for various lengths of time at 0.8 A to obtain a range of state of charge; their phase angles were measured with a Hewlett-Packard HP3575A gain-phase meter at 35 Hz; and they were discharged at 5 A 0.1 V to determine their state of charge in ampere-hours of capacity. The phase angle state-of-charge data were subjected to second-order polynomial curve fitting by means of least-squares analysis. The probable errors obtained from the least-squares analysis were used to judge the quality of the measured correlation between phase angle and state of charge. In order to determine how the correlation might be affected through cell use, the four extensively cycled cells with more than 3700 charge-discharge cycles and three cells with less than 40 such cycles were tested. The effect of temperature on the correlation was also studied.

9177 (AD-A—084935) A study of aircraft NiCd battery state-of-charge measurement by phase meter. Interim report. Martinelli, M.R.; Mayer, S.W.; Badcock, C.C. (Aerospace Corp., El Segundo, CA (USA). Chemistry and Physics Lab.). 30 Apr 1980. Contract F04701-79-C-0080. 35p. NTIS, PC A03/MF A01.

Experiments were performed to determine if the phase angle between alternating voltage and current could be used to predict, within a probable error of 5 percent, the state of charge of vented NiCd aircraft batteries. A 22 A-hr, 19-cell Gulton type MS24497-4 battery and several individual cells from that battery were tested in these experiments. The battery was charged for various lengths of time at 11 amperes to obtain a range of state of charge. Battery phase angle and individual cell phase angles were measured with a Hewlett-Packard HP-3575A gain-phase meter at frequencies of 350, 100, 35, 17.5, and 11 Hz; and the cells were discharged at 11 amperes to 0.1 V (1.9 V for the battery) to determine their state of charge in ampere-hours of capacity. The phase-angle, state-of-charge data were subjected to second-order polynomial curve fitting by means of least-squares analysis. The probable errors obtained from the least-squares analyses were used to judge the quality of measured correlation between phase angle and state of charge. The results for the individual cells were, on the whole, quite poor, although two of the individual cells tested achieved the stated goal of a probable error of 5 percent for the correlation between phase angle and state of charge. The 19-cell battery gave the best results with a probable error of 3.8 percent measured at 11 Hz.

9178 (AD-A—085154) Non-aqueous electrode research. Interim technical report, 1 October 1978-25 October 1979. Keil, R.G.; Hoenigman, J.R.; Moddeman, W.E.; Wittberg, T.N.; Peters, J.A. (Dayton Univ., OH (USA). Research Inst.). Mar 1980. Contract F33615-77-C-3156. 76p. NTIS, PC A05/MF A01.

This report describes work carried out in the second 13 months of a 33 month contract to characterize the passive films formed on anodes commonly used in non-aqueous battery cells, and to identify cell reaction products formed at the carbon cathode commonly used in these cells.

9179 (ANL—80-130) Post-test examinations of Li-Al/FeS/sub x/ secondary cells. Battles, J.E.; Mrazek, F.C.; Otto, N.C. (Argonne National Lab., IL (USA)). Dec 1980. Contract W-31-109-ENG-38. 75p. NTIS, PC A04/MF A01.

Post-test examinations were conducted to determine failure mechanisms, electrode morphologies, and in-cell corrosion of cell components, and to recommend appropriate design changes for improved cell performance and reliability. The reactive electrode materials required the design and construction of a special metallographic glovebox facility. Combinations of macro- and microscopic examinations determined that electrical short circuits were the predominant causes of cell failure. The major short circuit mechanism was extrusion of active material from one electrode and its subsequent contact with the opposing electrode (opposite polarity). Other mechanisms for short circuits included metallic deposits across separators, metallic deposits across the feedthrough insulator (electrolyte leakage and corrosion), equipment malfunctions, cell assembly difficulties, etc. Post-test examinations confirmed that the short circuits were of mechanical origin; appropriate design changes were, therefore, recommended. Extensive microscopic examinations were conducted on both negative and positive elec-

trodes to determine the morphology. Agglomeration of Li-Al was observed in the negative electrodes of most multiplate cells. Examinations showed that the sulfides in the positive electrode remained as discrete particles in an electrolyte matrix. Also discussed are the results of post-test examinations to determine the following: lithium gradients in the negative electrodes, electrode expansion, materials distribution, copper deposition within electrode separators of FeS cells, Li_2S deposits within electrode separators of FeS_2 cells, and the in-cell corrosion of current collector materials in positive and negative electrodes. 50 figures, 7 tables.

9180 **(UCRL-Trans—11656) Studies on metallic zinc fuel cells.** Sakai, T.; Kumeda, M.; Nishizawa, N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1980. Translation source information not available . 6p. NTIS, PC A02/MF A01.

The fabrication and performance testing of air-zinc batteries is described. Both single cells and composite cells were studied. Discharge characteristics obtained are plotted. 4 figures. (RWR)

9181 **Recent progress in lithium/iron sulfide battery development.** Barney, D.L.; Steunenberg, R.K.; Chilenskas, A.A. (Argonne National Lab., IL). pp 197-204 of 15th Intersociety Energy Conversion Engineering Conference. New York, NY; American Inst. of Aeronautics and Astronautics (1980).

From 15. Intersociety Energy Conversion Engineering Conference; Seattle, WA (18 Aug 1980).

A joint effort by Argonne National Laboratory and industrial subcontractors is aimed at the development of high-temperature lithium/iron sulfide batteries for electric-vehicle propulsion and stationary energy storage. The battery cells have lithium-alloy (Li-Al or Li-Si) negative electrodes, iron sulfide (FeS or FeS_2) positive electrodes, and molten LiCl-KCl electrolyte. A 40-kW h electric-vehicle battery, designated as Mark IA, was fabricated in 1979. During startup heating prior to electrical testing, a short circuit developed in one of the modules, causing a progressive failure of all the cells in the module. In the subsequent Mark II program, various improvements are being made in the cells and battery hardware to eliminate the potential failure mechanisms. In the cell development effort, multiplate cells having as many as three positive and four negative electrodes have been fabricated and tested successfully. In the battery development area, work is in progress on thin, high-efficiency thermal insulation to be used in the battery containment vessel. A charger equalizer concept was developed; with this concept, the major portion of the charge is added to the battery as a whole, and then the individual cells are charged to a predetermined cutoff voltage. A charging system that incorporates this concept has been tested. 2 figures, 8 tables.

29 ENERGY PLANNING AND POLICY

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 9207, 9279, 9309

9182 (ORNL—5638, pp 88-101) **Economic Analysis Section.** Takayama, T.; Wilbanks, T.J. Jun 1980.

In Energy Division annual progress report for period ending September 30, 1979.

The ORNL electricity-demand-forecasting system, which is discussed briefly, consists of three major components: (1) a state-level electricity demand (SLED) forecasting model; (2) a service-area disaggregation model; and (3) a load-distribution model. By use of MULTIREGION and REBS, an analysis of regional impacts of higher oil prices and coal-production patterns was completed in connection with DOE's preparation of NEP II. The results indicated that responses to different price levels of imported oil vary most in regions expected to show the most rapid growth in population and employment; higher price levels tend to dampen the rate of growth. Development of western coal will tend to benefit the economies of some areas in the West significantly more than others, whereas the benefits from development of eastern coal are spread more evenly throughout the region. The ORNL residential- and commercial sector models were used to calculate the national and regional effects of building energy performance standards (BEPS) under consideration by DOE. For the so-called nominal standard, set to minimize life-cycle costs using more or less conventional building techniques, the energy savings in the residential sector for the nation over the next 20 years was estimated to be about 11 EJ. The net current value of the benefits of the standard (fuel bill savings minus the increased cost of construction and the cost of implementing the program) was calculated to be about $3 billion over the 20-year period. For the commercial sector, the calculations are much less certain, but the estimates of energy and dollar savings were 27 EJ and $2.6 billion, respectively.

9183 **Linkage between the models of the EC energy-modelling system.** Fontela, E.; Jacot-Guillarmod, J.L. Luxembourg; Commission of the European Communities (1980). 116p. (EUR—6775-EN). European Community Information Service, Washington, DC.

The European Communities energy-modeling program includes the development of a comprehensive medium-term model of the energy system and its interaction with the economic system. It was decided that a substantial portion of the program should be devoted to implementation of existing models, resulting in a problem of linking different models. Chapter 1 describes the general concept of linkage in very simple terms and tries to reach a set of final conclusions following the different discussions held between the model builders participating in the entire program and also the comments made by different review committees and outside experts invited by the EC. Chapter 2 describes in detail the process of the Linkage from EXPLOR to EFOM (in its two versions) and describes the data used for the French test run. Chapter 3 deals with the final form of the feed-back linkage from EFOM to EXPLOR and Chapter 4 with the relations between EURECA and EXPLOR. Part Two describes the existing computer programs for the four types of linkages envisaged. (MCW)

2902 Economics And Sociology

9184 (ORNL—5638, pp 51-87) **Regional and Urban Studies Section.** Davis, R.M. Jun 1980.

In Energy Division annual progress report for period ending September 30, 1979.

The principal objective of the RUS Section is to conduct research and integrated assessments of the social, economic, and environmental effects of alternative energy development and use patterns at the regional and national levels. The programs are designed around three interacting themes: (1) energy technology assessments; (2) energy use analysis; and (3) energy information validation. During FY 1979 the major sources of Department of Energy (DOE) support were the Office of the Assistant Secretary for Environment (EV), the Energy Information Administration (EIA), the Office of Conservation and Solar Applications (CS), the Office of the Assistant Secretary for Energy Technology (ET), and the Economic Regulatory Administration (ERA). Other work was funded by the Department of the Interior (DOI), the Nuclear Regulatory Commission (NRC), and the Water Resources Council (WRC). The three program technical thrusts of work are described, followed by brief highlights from the section's five research groups.

9185 **(PNL—2410(Rev.2)) Analysis of Federal incentives used to stimulate energy production.** Cone, B.W.; Brenchley, D.L.; Brix, V.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1980. Contract AC06-76RL01830;EY-76-C-06-1830. 393p. NTIS, PC A17/MF A01.

Solar energy's share in the national energy budget has caused policy makers to speculate on the reasons for the large difference between present and potential use. Complex technical, economic, legal, institutional, and political interrelationships appear and an attempt is made to present an understanding of that relationship and to enhance the design of solar energy policy. Federal incentives that have been previously used on other energy sources are examined and the report identifies, quantifies, and analyzes such incentives and relates them to current thought about solar energy. The chapters presented are: A Theoretical Approach to Analyzing Incentives for Energy Production; Generic Analysis of Energy Incentives; Nuclear Energy Incentives; Hydroenergy Incentives; Coal

Energy Incentives; Oil Energy Incentives; Natural Gas Energy Incentives; and Electricity. Conclusions with respect to solar energy policy for each of these are summed. (MCW)

9186 Projecting the regional economic impacts of energy development. Wendling, R.M. (Dept. of Energy, Washington, DC); Ballard, K.P. *Growth and Change (U.S.);* **11**: No. 4, 7-17(Oct 1980).

Changes in Federal energy policy create incidental economic impacts that affect output, income, employment, and other macroeconomic variables which are largely ignored. A methodology for analyzing incidental multi-regional impacts uses the National Regional Impact Evaluation System (NRIES), which integrates 51 state econometric models into a national five-to-ten year framework to determine the implications of expanded coal use. The NRIES model simulates two advanced production scenarios at a single state (Montana) and a multiregional/national level. The effects of policy change appear as political and economic disruptions that cannot be contained within a single region. 14 references, 2 figures, 7 tables. (DCK)

9187 Adjustment issues of impacted communities or, are boomtowns bad. Brookshire, D.S.; d'Arge, R.C. *Natural Resources Journal (U.S.);* **20**: No. 3, 523-546(Jul 1980).

The impacts of new energy development on local areas probably range somewhere between overwhelming the community and spurring new opportunities, with the benefits and harm unevenly distributed among the population. Past experience tells us that many towns have survived boomtown adjustments without government subsidies to offset the impacts. A full-cycle assessment of a boomtown to determine the adjustment benefits over time indicates that the resulting community is not always harmed by rapid development. A test of the hypothesis that an energy impact directly induces higher crime rates suggests that, while the mix of crimes changes, the net effect depends on how particular crimes are valued. A statistical analysis of consumer surplus loss shows that secondary impacts, such as wildlife reduction, are greater than direct impacts. 32 references, 3 figures, 4 tables. (DCK)

9188 Economic and financial parameters of economical energy investments in the French chemical industry. Chef, J.; Picard, J.J. Brussels, Belgium; Commission of the European Communities (1980). 260p. (In French). (EUR—6832-FR). European Community Information Service, Washington, DC.

The investments option pattern is divided into two dependent subsystems: the financial stimulations and the economical and social stimulations corresponding to the financial results examined. The discounted cash flow method is used to describe the financial life of the investment and the time required to recover the invested capital. Calculations were carried out with the data processing RISCH program. Discounted cash flow is examined considering investment external effects and pressure of the economical and social stimulations on the firms's investment policy. The pattern has been tested on investment cases by the French chemical and petrochemical companies, specifically, concerning projects already carried out or investments to be realized. The analyzed cases show that every cash flow realization is related to probability appearance upon the project's economical horizon of a certain average inflation rate of fuel or other different means of energy. Therefore, this shows a risk of nonrealization of the expected discounted cost flow at the moment of the decision (risk of error). By an homothetic way, the discounted cash flow which incorporates the global incidences or external effects, undergoes the same uncertainty. An attempt is made to measure the risk factors related to the decider's value, the parameters integrated in assessment of choice criteria, the techniques used, the inflation, financial means, and the energy price fluctuations.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 8735, 9184, 9620, 9644, 9664, 9682

9189 (ANL/AA—22) Methodology for evaluation of intertechnology tradeoffs. Buehring, W.A.; Whitfield, R.G.; Wolsko, T.D. (Argonne National Lab., IL (USA)). Oct 1980. Contract W-31-109-ENG-38. 111p. NTIS, PC A06/MF A01.

A methodological interface between the impact-assessment process and the decision maker is developed. Although the presented method is rather widely applicable, it is particularly helpful for those who are dealing with the complex problems surrounding the environmental, health, and economic impacts of alternative-energy technologies and policies. These problems are characterized by: (1) multiple conflicting objectives, (2) uncertainty, (3) variable outcomes over time, and (4) dynamic behavior. The issues are complicated further by the different preference structures of stakeholders, analysts, and decision makers. Minimum cost. benefit-cost, and decision analysis are three approaches that have been taken with respect to this type of problem. Decision analysis has been found to offer certain advantages over the others in that impact aggregation and uncertainty can be incorporated rather successfully. The recommended methodology has three basic stages: (1) problem formulation, (2) objective hierarchy selection, and (3) alternatives evaluation. The output of the formal analysis is assessment information that can serve as the basis of the informal processes that result in policy statements or recommendations.

9190 (DOE/EV/10019—01(Vol.1)) Carbon Dioxide Effects Research and Assessment Program. Environmental and societal consequences of a possible CO_2p induced climate change: a research agenda. (American Association for the Advancement of Science, Washington, DC). Dec 1980. Contract AS01-79EV10019. 122p. NTIS, PC A06/MF A01.

In adding carbon dioxide to the atmosphere, mankind is unintentionally conducting a great biological and geophysical experiment. This experiment can be expected to increase scientific understanding of ecological systems and of the processes in the ocean and the atmosphere that partially determine world climate. But from the standpoint of governments and peoples, the major problem to be solved is to understand the nature of the impacts on societies of rising levels of atmospheric carbon dioxide (CO_2), with the objective of avoiding or ameliorating unfavorable impacts and gaining most benefit from favorable impacts. The research program proposed herein is designed to provide the understanding needed to achieve this objective. It is based on a recognition of the distinctive characteristics of the CO_2 problem. It is concluded that three kinds of research on the consequences of rising levels of atmospheric carbon dioxide and possible climatic changes are called for: assessment of risks; research to enhance beneficial effects and lessen harmful ones, where this is possible, and to slow down rates of carbon dioxide emission; and study of potential social and institutional responses to projected climatic changes.

9191 (ORNL—5638, pp 23-50) Environmental Impact Section. Row, T.H. Jun 1980.

In Energy Division annual progress report for period ending September 30, 1979.

The Environmental Impact Section is primarily concerned with the preparation of environmental assessments and statements and with the development of assessment methodologies and confirmatory research for energy technologies. The year brought about a significant decline in the Section's work on nuclear power plants, a combination of the decline in nuclear power development and a planned withdrawal from the activity. The technical assistance to NRC on nuclear-fuel-cycle facilities continued to be a large effort. The number of projects (11) was identical to that for last year and involves fuel fabrication, ore-buying stations, in-situ mining, and uranium mills. A recently completed study on alternative screening devices for steam-electric power plants is recognized as a major contribution in this area. Continuing emphasis on fossil technologies is demonstrated by the accomplishments of the Fossil Energy Environmental Project (FEEP). Activity in this area continues to increase as the synthetic-fuel-demonstration plants support work expands. The environmental reports on most of the facilities have been received, and a major part of our staff is working on the environmental statements for these facilities.

2904 Natural Resources

9192 (ANL/EES-TM—96(Vol.2), pp 41-47) **Priorities for increasing efficiency of water use.** Gilbert, J.B. Aug 1980.

From 12. IECEC conference on energy conservation in the treatment of industrial wastewaters; New Orleans, LA, USA (10 Dec 1979).

The conservation of water and attitudes of the populace and industry are discussed. Some basic programs in the water industry achieve conservation goals by simply emphasizing good management practices. Metering water flow is the most obvious way that a customer becomes aware of his water use. Energy saving in the home is primarily a factor of having to heat less water. At the production end, the major energy consumption points are treatment and distribution. It has been pointed out that measurable energy savings can only be achieved when a combination of practices is implemented; and that all conservation or energy-saving programs do not apply to all water systems. (MCW)

9193 (ANL/EES-TM—96(Vol.2), pp 69-78) **Energy optimization in groundwater development and production.** Ford, M.E. Jr. (Boyle Engineering Corp., Ventura, CA). Aug 1980.

From 12. IECEC conference on energy conservation in the treatment of industrial wastewaters; New Orleans, LA, USA (10 Dec 1979).

Energy optimization from wells in sand and gravel aquifers is considered. Energy optimization in ground water development and production is concerned with minimizing pumping lifts and increasing pumping efficiencies. The potential for energy savings is significant. Minimization of drawdown during pumping begins with proper well design and construction and well designed pumping equipment. Drawdown in wells, formation loss, well loss, and pumping efficiency are factors discussed in detail to show that power savings can be significant. (MCW)

9194 (ANL/EES-TM—114) **Local air quality constraints on energy growth, 1985-1990.** Streets, D.G. (Argonne National Lab., IL (USA)). Mar 1980. Contract W-31-109-ENG-38. 65p. NTIS, PC A04/MF A01.

This report examines the potential future conflict between energy growth and environmental protection, from the perspective of siting constraints imposed by requirements of the Clean Air Act Amendments of 1977. County-level projections of additional utility powerplant capacity and increases in industrial coal, oil, and gas consumption are derived for the period 1985 to 1990. Emissions of sulfur dioxide and particulate matter, after the application of appropriate control systems, are converted to changes in ambient air quality using a proportional modeling approach. These changes are then compared with Nonattainment and Prevention of Significant Deterioration requirements, and the energy activity is considered to be constrained if a violation is projected. Total percentages of constrained energy activity are developed for the nation, and the geographical patterns of significant impacts are presented.

9195 (DOE/EIA—0233(80)) **EIA data index: an abstract journal.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Dec 1980. 767p. NTIS, PC A99/MF A01.

The individual tables, graphs, and formatted data presented in the statistical publications of the Energy Information Administration (EIA) are abstracted and indexed. Included are a complete subject index and a report number listing for all EIA publications as well as complete ordering information for these publications. The abstracts of the tables and graphs are arranged by broad subject categories (e.g., coal, petroleum, natural gas, energy analysis and modeling) with further division occurring by subcategories (e.g., reserves, drilling and production, processing). Included here are those publications and their statistical contents which were released by the EIA from its formation in October 1977 through approximately the first half of 1980. Updates will be on a semiannual basis. The EIA Data Index is a companion volume to the EIA Publications Directory: A User's Guide (DOE/EIA-0149), which provides abstracts and indexes to all EIA publications at the document level. Both of these publications are generated from the Federal Energy Data Index (FEDEX) data base which has been developed by the EIA in cooperation with the Technical Information Center of the US Department of Energy.

9196 (DOE/EV/10180—01) **Institutional constraints on alternative water for energy: a guidebook for regional assessments.** (Muir (John) Inst. for Environmental Studies, Inc., Napa, CA (USA)). Nov 1980. Contract AC04-80EV10180. 229p. NTIS, PC A11/MF A01.

Basic information is presented about the legal, political, and social constraints faced by energy developers in the acquisition of water from underground, irrigation return flow, municipal waste, and saline sources. It is a guide to those institutional constraints which are general and pronounced enough to be important for regional assessments. First, attention was focused on the acquisition phase of the water use cycle. Second, constraints were analyzed primarily from a regional, rather than state-by-state, perspective. Emphasis was placed generally on the West - particularly the synfuel-rich Rocky Mountain states, the East, and Mid-West, in that order. Alaska and Hawaii were not surveyed. Third, the study focuses on the constraints associated with groundwater, municipal waste, irrigation return flow, and sea water, in that order. The phrase, institutional constraints, as used in the study, means legal, social, economic, and political restrictions, requirements, circumstances, or conditions that must be anticipated or responded to in order to acquire water for energy development. The study focuses primarily on legal constraints and secondarily on political constraints, because they tend to encompass or reflect other forms of institutional constraints.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 8744, 8767, 9189, 9219, 9224, 10056

9197 (DOE/ER—0092) **Capsule review of the DOE research and development and field facilities.** (Department of Energy, Washington, DC (USA)). Sep 1980. 53p. NTIS, PC A04/MF A01.

A description is given of the roles of DOE's headquarters, field offices, major multiprogram laboratories, Energy Technology and Mining Technology Centers, and other government-owned, contractor-operated facilities, which are located in all regions of the US. Descriptions of DOE facilities are given for multiprogram laboratories (12); program-dedicated facilities (biomedical and environmental facilities-12, fossil energy facilities-7, fusion energy facility-1, nuclear development facilities-3, physical research facilities-4, safeguards facility-1, and solar facilities-2); and Production, Testing, and Fabrication Facilities (nuclear materials production facilities-5, weapon testing and fabrication complex-8). Three appendices list DOE field and project offices; DOE field facilities by state or territory, names, addresses, and telephone numbers; DOE R and D field facilities by type, contractor names, and names of directors. (MCW)

2906 Nuclear Energy

9198 **Manpower development for nuclear power.** Mautner-Markhof, F. (International Atomic Energy Agency, Vienna (Austria). Div. of Nuclear Power and Reactors). pp 359-375 of Manpower requirements and development for nuclear power programmes. Proceedings of an international symposium held by the IAEA at Saclay, 2-6 April 1979. Vienna, Austria; International Atomic Energy Agency (1980).

From International symposium on manpower requirements and development for nuclear power programs; Saclay, France (2 Apr 1979).

The necessity and importance of manpower development for nuclear power programmes is becoming increasingly recognized by both the developing and developed Member States of the Agency. It is generally agreed that there is a very widespread and large underestimation of the need and numbers of highly qualified manpower required to ensure the safety and reliability of nuclear power, and of the economic and social consequences of the lack of such manpower. There is a fundamental need for and responsibility of a developing country to provide, at the outset of a nuclear power

project, the national organization and resources for planning and implementing a manpower development programme. The basic considerations which go into manpower planning and implementation are discussed, in particular the factors influencing a manpower development programme and the need for a core of indigenous qualified manpower from the beginning of planning a nuclear power project, even if it is a turn-key project. Indigenous manpower that has both the technical expertise and extensive knowledge of local conditions is best equipped to adapt successfully imported nuclear power technology to the needs of a developing country, thus providing increased self-sufficiency as well as safe and reliable nuclear power. Also discussed are: the general nature of the interface between manpower development and national participation; education and on-the-job training; manpower requirements for a nuclear power project; and manpower for a nuclear regulatory body. IAEA activities in manpower development which are discussed include: the IAEA Guidebook on Manpower Development for Nuclear Power; the IAEA Programme of Training Courses in Nuclear Power; on-the-job training; and the IAEA Fellowship Programme.

9199 **National energy issues: how do we decide. Plutonium as a test case.** Sachs, R.G. (ed.). Cambridge, MA; Ballinger Publishing Company (1980). 336p. (CONF-780998—).

From National energy issues; Argonne, IL, USA (29 Sep 1978).

This volume contains the proceedings and discussions of a Symposium at Argonne National Laboratory. The discussions demonstrate how the variety and diversity of critical inputs contribute directly to the complexity of national energy policy-making. Plutonium was chosen as a case study for this inquiry because of its controversial nature and its important domestic and international implications. Separate abstracts have been prepared for individual papers for inclusion in the Energy Data Base. (DMC)

9200 **Climatic variability and agriculture in the temperate regions.** McQuigg, J.D. pp 406-425 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

This paper deals primarily with the production of wheat and coarse grain (largely used as animal feeds). Cereal crop agriculture is discussed in relation to its world trade importance and its yield, area cultivated, and productivity primarily in the US. However, the author notes the applicability of the issues to world conditions and to pastoral farming, especially climate considerations. (PSB)

2907 Transport And Storage

REFER ALSO TO CITATION(S) 9264, 9323, 9324, 9325, 9326, 9327, 9328, 9329, 9330, 9331, 9332, 9333, 9334, 9335, 9336, 9338, 9339, 9340, 9341, 9342, 9343, 9344, 9345, 9346, 9347, 9348, 9349, 9350, 9351, 9352, 9353, 9356, 9357, 9358, 9359, 9360, 9361, 9362, 9363, 9364, 9365, 9366, 9370, 9371, 9372, 9373, 9374, 9376, 9377, 9379, 9381, 9382, 9384, 9385, 9386, 9388, 9389, 9390, 9391, 9392, 9393, 9394, 9395, 9396, 9397, 9527, 9528

9201 (CONF-800419—(Vol.1), pp 35-36) **Role of technology for tomorrow's transportation: legal.** Montgomery, R.E. Jr. (Hogan and Hartson, Washington, DC). Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

This panel discussed the impact of regulations and state laws, anti-trust laws, patent laws, and environmental laws on the automotive industry. (LCL)

9202 (CONF-800419—(Vol.1), pp 47-48) **Role of technology for tomorrow's transportation: consumer.** McDowell, D.J. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

A survey of automobile owners is described in which 44% indicated that the most recent car they purchased was smaller than the last; 37% said they expect to downsize on their next purchase; and only 7% indicated that their next car would be larger. It was clear from the survey that motorists and car buyers want smaller, more efficient cars, and they do not care what technology is applied to attain this goal whether it is improved spark ignition engines, or a move to diesel, turbine, Stirling or electric propulsion. (RCK)

9203 (CONF-800419—(Vol.1), pp 53-58) **Market trends, projections, and applications: US automotive industry trends for the 1980's.** Van Hull, P.; Cole, D.E. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Automobile industry experts were polled to develop a consensus as to future technological, market, and management trends. The results indicate a technical trend toward lighter weight, 4-cylinder, front drive, less maintenance vehicles, no further tightening of emission standards after 1985, an average 2% per y growth rate in car sales, a 3% growth rate for the sales of auto parts, and increased investment and productivity in automobile and auto parts manufacturing plants. (LCL)

9204 (CONF-800419—(Vol.1), pp 103-114) **Market trends, projections, and applications: changes in motor carrier activity and energy consumption.** Millar, M. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

This summary presents a portion of the preliminary findings from ongoing research being conducted for the US Department of Energy. Initially, this research focused on historical changes in the technological characteristics of the transportation stock and auxiliary equipment. Current efforts are directed toward developing and improving projections of modal activity and energy consumption as a baseline against which to assess the likely performance of DOE conservation initiative. Information is included on trends in truck ownership, size and weight, operation, and fuel efficiencies. Conversations with carriers and manufacturers, as well as secondary source information, indicate that motor carriers are very responsive to energy supply constraints and are seeking operational and new technology strategies to improve fleet fuel efficiency. The most obvious concern for freight transportation carriers is in increased payload capacities of the vehicles. This trend to up-size freight vehicles is occurring at the same time that personal passenger vehicles are being down-sized. Increased pressure on states to ratify increased size and weight limits for trucks is likely to show near-term, energy intensity improvements. Increased load factors and vehicle-carrying capacity will hedge increased fuel costs for truckers. Other actions that carriers are taking to reduce fleet consumption include more vigorous self-enforcement of the 55 mph speed limit, installation of energy conservation accessory equipment, driver efficiency measures, and aggregating shipments to increase back-haul loads. (LCL)

9205 (CONF-800419—(Vol.1), pp 115-132) **Market trends, projections, and applications: resource allocation for minimum total cost: automobile fuel economy versus synthetic fuel production.** Leach, H.J. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The objectives in this project are: to estimate, in comparable terms, the cost of fuel economy improvement and alternative fuel production for several levels of production or savings of fuel; to estimate the feasible implementation rates, the required capital investment, the consumer costs, and the marginal costs of the fuel produced or saved by these two strategies; and to investigate the sensitivity of the cost of these strategies to factors such as: alternative financing methods and tax incentives and other items such as automobile and light-truck sales and mix. Fuel economies for proposed more fuel-efficient cars and the vehicle fleet fuel consumption with various technological improvements are estimated. Production economics for alternative fuels produced from shale, coal, and biomass are considered. The results of these estimates are that by the year 2000 a savings of 3 to 4 million barrels of fuel per day are possible through improved fuel economy technology versus alternate fuel production of about 2 to 2.5 barrels per day at that time. Between 1980 and 1990 capital investment for fuel economy technology would exceed that for synfuel production technology. After 1990 the reverse is predicted. Overall from the late 1980's onward the fuel economy technology route appears more economically advantageous than synfuel production. (LCL)

2910 Conservation

REFER ALSO TO CITATION(S) 9192, 9258, 9260, 9276, 9277, 9288, 9289, 9337

9206 **(DOE/SF/10758—T1) Barriers to energy conservation component of the pilot program of the Energy Extension Service. Final report.** (Ragan (James) Associates, Pacific Palisades, CA (USA)). Oct 1980. Contract AC03-79SF10758. 53p. NTIS, PC A04/MF A01.

Pilot EES program experiences with Barriers to Energy Conservation (BECS) are presented. Issues dealing with methods of obtaining energy conservation barriers information from target audiences and the extent to which the BECS part of EES should be operated on a planned and organized basis are examined. Chapter I summarizes information on the barriers actually heard from EES clients and what progress was made in dealing with those barriers. Chapter II describes the BECS process as planned by DOE and the pilot states at the beginning of the pilot EES program. Chapter III describes the BECS process as the pilot states and DOE actually operated it over the two-year period. Chapter IV presents observations and findings on BECS in the pilot program, and offers recommendations on the design and operation of BECS in the nationwide EES program.

9207 (ORNL—5638, pp 102-134) **Conservation and Use Analysis Section.** Mixon, W.R. Jun 1980.

In Energy Division annual progress report for period ending September 30, 1979.

This section is primarily responsible for analytical activities concerned with the relative costs, benefits, acceptability, and potential for widespread implementation of technology and policy options to conserve energy and scarce resources. Activities encompass two general approaches: (1) development and use of engineering-economic modeling to assess the effectiveness of policies, prices, and technological innovations on reducing the end-use demand for fuels in the residential, commercial, and industrial sectors; and (2) comparative assessment and demonstration of energy-supply options that conserve fuels and other resources. Within the first approach, major accomplishments of residential and commercial sector modeling included quick-response analyses for sponsors, comprehensive analyses to help develop and evaluate the effects of proposed Building Energy Performance Standards (BEPS), and improvements in both engineering and economic aspects of the models. The Oak Ridge Industrial Model (ORIM), which represents nine industry subsectors in ten regions, was completed and installed at the Energy Information Administration (EIA). Activities within the second approach included demonstration and evaluation of new technologies for electric-utility load management, assessment of impacts of integrating dispersed generation in a utility, assessment of a large district-heating system coupled to cogeneration, and analysis of appropriate uses of small solar-thermal power systems.

9208 (ORNL—5638, pp 135-169) **Conservation and Conversion Technology Section.** Michel, J.W. Jun 1980.

In Energy Division annual progress report for period ending September 30, 1979.

This new section was formed to consolidate related activities already at the Y-12 site together with some other existing program-management work. This section includes all the heat-pump R and D and program management (subcontracted) work, the Annual Cycle Energy System (ACES) project, the appliance-efficiency program, innovative structures, industrial waste heat utilization, a geothermal energy project on waste heat rejection, and ocean thermal energy conversion work on ammonia heat transfer and alternate cycles development. No major new programs began this past year. The ACES project continued with a highly successful year of operation following the improvements made at the beginning of the year; ice was stored through most of the summer to provide the space cooling required. The appliance-efficiency program demonstrated significant advances in the energy efficiency of water heaters, refrigerator-freezers, and refrigerant compressors. In the geothermal energy project, the design of fluted-tube condensers for operation in demonstration plants was completed and procurement actions were initiated.

9209 **Overcoming social and institutional barriers to energy conservation.** Blumstein, C.; Krieg, B.; Schipper, L.; York, C. (Univ. of California, Berkeley). *Energy (Oxford) (England);* **5**: No. 4, 355-371(Apr 1980).

Although economically rational responses to the energy crisis, energy-conservation actions may be hindered by social and institutional barriers. The nature of these barriers is explored and a taxonomy of barriers is proposed. Results of a series of interviews provide examples of the different types of barriers. Strategies for overcoming barriers are examined and some criteria for evaluating such strategies are developed. The importance of considering not only the efficiency of strategies in achieving the goal of energy conservation, but also their impacts on other--possibly competing--social and economic goals is emphasized. The need for increased efforts aimed at overcoming barriers and further research into the nature of these barriers is discussed. 4 refs.

2920 Supply, Demand, And Forecasting

9210 (CONF-800419—(Vol.2), pp 781-790) **Engine fuel relationships: technical aspects of fuel supplies.** Wagner, T.O. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

US transportation energy supplies and their availability are discussed briefly.

9211 **New policy imperatives for energy producers.** El Mallakh, R.; El Mallakh, D.H. (eds.). Boulder, CO; International Research Center for Energy and Economic Development (1980). 269p. (CONF-7910199—).

From 6. ICEED conference on new policy imperatives and options for energy producers; Boulder, CO, USA (8 Oct 1979).

Conferences sponsored by the International Research Center for Energy and Economic Development are organized toward increasing the understanding of the multifaceted problems in energy - economic, technical, and political - that confront not just the consuming industrial powers but the developing OPEC and non-OPEC producers and, in particular, the Third World countries whose plight is extreme. All types were represented at this 6th conference, and the 21 papers mirror the diversity of ideas and, at the same time, the very real areas where cooperation and coordination are clearly both possible and desirable. A separate abstract was prepared for each paper for Energy Abstracts for Policy Analysis (EAPA); one abstract was selected for Energy Research Abstracts (ERA).

9212 **Energy: the next twenty years.** Ruff, L.E. (Brookhaven National Lab., Upton, NY). pp 77-85 of New policy imperatives for energy producers. El Mallakh, R.; El Mallakh, D.H. (eds.). Boulder. CO; International Research Center for Energy and Economic Development (1980).

From 6. ICEED conference on new policy imperatives and options for energy producers; Boulder, CO, USA (8 Oct 1979).

Dr. Ruff was one of a group of 19 people involved in the Ford Foundation study, Energy: the Next Twenty Years (Cambridge, Ballinger Publishing Co., 1979). He says that as long as the metaphors of war dominate public discourse and policy formation in energy - the idea that there is a grand strategy for final victory once the regulators, resources, patriots, etc., are mobilized - the energy crises will persist, even worsen. He feels that not only is the idea fundamentally misleading and ultimately counterproductive, but the inappropriate policies it encourages have only exacerbated the most serious problem of all - the possibility that poor management of the energy situation could lead to a real, not just metaphorical, war. The US in the international scene regarding foreign policy and energy problems is examined, and world oil prices and OPEC are discussed. Dr. Ruff concludes that energy prices should reflect the realities of the energy situation and energy policy should encourage research and development; further, some government assistance is necessary, but the energy problem is best dealt with by economic mechanisms, as similar problems have been in the past.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 8717, 8718, 9185, 9197, 9211, 9212, 9216

9213 (DOE/RG—0050) Guideline No. 3 under the Public Utility Regulatory Policies Act of 1978: automatic adjustment clauses standard. (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). Dec 1980. 43p. NTIS, PC A03/MF A01.

On April 24, 1980, the Department of Energy (DOE) issued a Notice of Proposed Voluntary Guideline for the Automatic Adjustment Clauses Standard Under the Public Utility Regulatory Policies Act of 1978 (45 FR 29234, May 1, 1980). This Notice discusses in the Preamble the public comments DOE received and presents the guideline in its final form as the Appendix. The objective of an automatic adjustment clause is to mitigate the effect on utility revenues of relatively volatile cost items which a utility purchases on a continual basis. The most important of such cost items is fuel, and this guideline focuses primarily on an automatic fuel-adjustment clause. The following are discussed: provision of incentives for effective fuel and power procurement practices; provision of incentives for economic and efficient generation of electricity; incorporation of automatic-adjustment charges into the rate structure; incentives for displacement of scarce fossil fuels in the generation mix; accounting and management audits; design of an automatic-adjustment clause; and need for an automatic-adjustment clause.

9214 Energy crises of 1919-1924 and 1973-1975: a comparative analysis of Federal energy policies. Clark, J.G. *Energy Systems and Policy (U.S.);* **4**: No. 4, 239-271(1980).

During the years 1916 to 1924, the United States was subjected to both real and feared energy shortages. Those years of coal strikes, transportation breakdowns, perceived oil scarcity, and world war compelled the Federal government to assume an unprecedented role in fuel-resource management. The Arab oil embargo of 1973 to 1974 precipitated another period of real and perceived energy shortages and intensified Federal intervention in energy-policy formulation. This paper compares Federal policies adopted or considered during these two crises toward production controls, price setting, distribution, and allocation. Attention is focused on the adversarial relationships of such special-interest groups as the major integrated oil companies and the so-called independents; the disputed need for Federal regulation to achieve equity in the distribution and allocation of scarce resources; and the unresolved debate concerning the impact of price and other controls on energy supply.

2940 Fossil Fuels

9215 Descriptive documentation for New Mexico Natural Gas Econometric Final Demand Model. Baxter, J.D.; Shaul, B.D. Santa Fe, NM; New Mexico Energy and Minerals Department (1981). 19p. (NP—25229).

The coverage provided by the New Mexico Natural Gas Econometric Final Demand Model extends over consumption, distributors, customers, and climatic data. Although the model has stand-alone capability, its main purpose is the computation of consumption and residential energy demands for scenario development in SWEEP. Demand curves and demand analysis come from the theory of the consumer and the analysis of utility maximization. This theory derives functions which give the relationships between the quantity of a good consumed and the price of that good, the price of other goods and the income of the consumer of the good. The principal simulation with the Natural Gas Econometric Final Demand Model is in the area of price changes. Since prices in energy sectors under most future scenarios are expected to change dramatically, the parameters P/sub NG/ and P/sub E/ can be adjusted upward to show the impact on Q/sub NG/, consumption of natural gas, while Y, per capita income, is held constant. (DMC)

9216 (NP—25215) Report of the IEA Coal Industry Advisory Board. (Organization for Economic Co-Operation and Development, 75 - Paris (France)). 1980. 53p. NTIS (US Sales Only), PC A04/MF A01.

This is the text of a report presented of the governing board of the International Energy Agency (IEA) at the ministerial level on May 22-23, 1979. The coal action program is discussed. Increased coal production and use is an international objective. The role of the Coal Industry Advisory Board (CIAB) in meeting this objective is described. The recommendations of the CIAB to governments and industry are included. The executive summary of the findings of the CIAB working group in the areas of coal use, coal production, infrastructure, international trade, environmental issues, and research and development is presented. The text of the principles for IEA action on coal adopted by the governing board of IEA at their May 22-23, 1979 meeting is included. (DMC)

9217 Descriptive documentation for New Mexico Petroleum and Natural Gas Supply Model. Lievano, R.J. Santa Fe, NM; New Mexico Energy and Minerals Department (1981). 31p. (NP—25231).

The objectives of the New Mexico Petroleum and Natural Gas Supply Model are: (1) to identify and describe the major economic and physical factors that influence the rate of oil and gas production; (2) to synthesize these factors into a consistent and comprehensive model of the industry; and (3) to provide New Mexico policymakers with a powerful and usable energy management tool. The model consists of four major interrelated components: exploration, reserves development, production, and state revenues. These four interact such that exploration generates additions to reserves based on given prices and costs of drilling; oil and gas reserves are then developed based on an optimal decline rate, from which an optimal development level is derived; the production component takes these incremental developments along with existing production and sums; state revenues are calculated based on the value of production.

9218 Oil from shale: the potential, the problems, and a plan for development. Lewis, A.E. (Lawrence Livermore Lab., Calif). *Energy (Oxford) (England);* **5**: No. 4, 373-387(Apr 1980).

A unitized management and development of the government-owned oil shale in Colorado will make it technically and economically practical to obtain very large production rates (1-5*10/sup 6/ bbl/day) of shale oil from this source. The estimated price is below world prices and could be less than /15/bbl. Private oil shale lands, on the other hand, provide a smaller though still important potential for production in terms of resource size and economic cost. Important differences exist in the nature of the oil-shale resource held by the government and that held by private companies. These differences are crucial not only in estimating production costs and incentives necessary for production but also in defining applicable technology. 23 refs.

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 8708

9219 (LA—8628-MS) Some long-term energy options. Bartlit, J.R.; Edeskuty, F.J. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 8p. NTIS, PC A02/MF A01.

Some energy options, although of little immediate use, still offer advantages which make them worthy of continued investigation to determine their feasibility and their potential. These technologies include the possibility of recovering vast amounts of methane from naturally occurring methane hydrates and the use of hydrogen as a fuel. The inherently high risk of these technologies for short-term payoff makes them a particularly appropriate concern for national laboratories.

9220 (LA-UR—80-3445) Use of non-petroleum fuels to reduce military energy vulnerabilities: self-sufficient bases and new weapon propulsion systems. Freiwald, D.A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 19p. (CONF-801239—1). NTIS, PC A02/MF A01.

From 46. Military Operations Research Society meeting; Newport, RI, USA (2 Dec 1980).

The US fossil synfuels program may not have significant impact on domestic fuel supplies until near the year 2000, resulting

in a continuing mobility fuels vulnerability for the US military until then. But there are other mobility fuel options for both propulsion systems and stationary base-energy sources, for which the base technology is commercially available or at least demonstrated. For example, for surface propulsion systems, hydrogen-fuel-cell/battery-electric hybrids may be considered; for weapons systems these may offer some new flexibilities, standardization possibilities, and multiple military-controlled fuel-supply options. Hydrogen-fueled aircraft may provide interesting longer-term possibilities in terms of military energy self-sufficiency and multiple supply options, as well as performance specifications. These scenarios will be discussed, along with possibilities for demonstrations in the MX-system ground vehicles.

2960 Electric Power

9221 (BNL—51288) Regional Issue Identification and Assessment Program (RIIA). Socioeconomic impacts of proposed power plants in the northeast: issue paper 1. Metz, W. (Brookhaven National Lab., Upton, NY (USA)). May 1979. Contract AC02-76CH00016. 23p. NTIS, PC A02/MF A01.

Each new major electric generating facility during its construction and operation periods presents a variety of social and economic consequences to the local, state, and regional areas. The potential for delay due to socioeconomic factors and the economic costs and benefits associated with proposed power plants are described with regard to two energy development scenarios: (1) Department of Energy National Energy Plan I and (2) a utility plan composite. Only proposed power plants with capacities over 400 MW and slated for completion by 1990 located in the three eastern federal regions (1, 2, and 3) are included.

9222 (DOE/EIA—0172(79)) Statistics of publicly owned electric utilities in the United States: 1979, energy data report. McEwan, P.; Ryan, S. (Department of Energy, Washington, DC (USA). Energy Information Administration). Dec 1980. 111p. NTIS, PC A06/MF A01.

Financial and operating information about publicly owned utilities in the United States are presented. This publication contains the annual reports for 162 Municipalities and 74 Federal projects whose annual operating revenues equal or exceed $5,000,000 or $1,000,000, respectively. Data from 11 municipalities which reported in 1978 and 6 federal projects (5 of which reported in 1978) were not received in time for inclusion in this year's publication. The US Department of Interior markets all the electric energy produced at projects of the US Department of the Army Corps of Engineers. The 1979 edition is constructed to include an index listing of names for each reporting publicly owned utility by State, or States, in which it operates. Federal projects are listed by the particular department operating that project. A summary for all utilities in total may be found at the begining of each section. These summaries include the balance sheet, and statements for income accounts, electric operating revenues, electric utility plants, electric operation and maintenance expenses, energy accounts, and physical quantities. The Year in Review is composed of statements from both Publicly Owned Municipal Electric Utilities and Federal Projects. It includes both financial and operational information.

9223 (EPRI-EA—1636) Cost uncertainty in programming models of electricity supply. Final report. Maddala, G.S. (Fletcher (A.L.) and Associates, Columbia, SC (USA)). Nov 1980. 90p. NTIS, PC A05/MF A01.

The purpose of this project is to review the literature on the stochastic programming approaches to the analysis of cost uncertainty and to examine their feasibility in programming models of electricity supply as used by electric utilities. The basic conclusion, after a careful and thorough review of this literature, is that these methods are not practicable when the cost-minimization programming problem incorporates the basic elements of variations in the heat-rate curve and start-up and stoppage costs with changes in the load-distribution curve. It is argued that these factors and also the rate-of-return constraint are important elements of the cost-minimization problem. Further, the marginal costs of the different types of output (base, intermediate, and peak) that one obtains from the solution to the cost-minimization problem are of important practical value in the implementation of marginal-cost pricing schemes. A practical approach for the incorporation of cost uncertainty would be to consider a probabilistic range of alternatives and solve the deterministic cost minimization for each alternative scenario, including the important elements in the analysis. Further analysis based on these probability distributions of minimum costs, can be based on the criterion of minimum expected costs or expected disutility of costs. For the latter, one needs some explicit utility functions, and some attention needs to be devoted to this problem.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 9262, 9277, 9278, 9287

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 8576, 8712, 8713, 8715, 8721, 8722, 8723, 8724, 8733, 8736, 8737, 8740, 8743, 8744, 8748, 8767, 8933, 8934, 8935, 9065, 9066, 9067, 9068, 9069, 9070, 9071, 9079, 9082, 9095, 9097, 9099, 9101, 9185

9224 (ANL/EES-TM—96(Vol.1), pp 11-14) **Department of Energy perspective on water and wastewater treatment.** Rines, C. (Dept. of Energy, Washington, DC). Aug 1980.

From 12. IECEC conference on energy conservation in the treatment of industrial wastewaters; New Orleans, LA, USA (10 Dec 1979).

9225 (LBL—11903) Forecasting the role of renewables in Hawaii. Sathaye, J.; Ruderman, H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1980. Contract W-7405-ENG-48. 33p. (CONF-8010152—1). NTIS, PC A03/MF A01.

From International Association of Energy Economists conference; Washington, DC, USA (5 Oct 1980).

Alternative future energy-supply systems for Hawaii are investigated. Other elements of the study examined future demand for energy, what indigeneous resources are available, what technologies will be sufficiently developed to exploit them, and what will be their social, economic, and environmental consequences. Each of the four counties in the state appear to have sufficient natural resources to supply nearly all of their energy needs. The island is in the belt of the northeast trade winds, has extensive high temperature geothermal resources, enjoys a higher average insolation than the mainland states, and the large temperature gradients and absence of a continental shelf make Hawaii a prime location for OTEC. The use of crops and trees to supply electricity and possibly liquid fuels can also be expanded. Results of a study for the County of Honolulu are presented. Projections of energy demand, the electricity generation mix, and electricity prices are presented to illustrate the methods developed to analyze the supply and demand options for the state. (MCW)

9226 Energy alternatives for small farms and rural communities in Appalachia. Blobaum, R.; Belden, J.; Harnik, P.; Beelar, P. West Des Moines, IA; Roger Blobaum and Associates (Jan 1980). 108p. (NP—25213). Appalachian Regional Commission, Washington, DC.

A six-month study of the Appalachian region finds that policymakers and farmers are both interested in small-farm and rural energy projects. Responses to the study's interviews indicate that the region's small farmers and rural people are favorable to demonstrations of owner-built energy systems. They agree that their energy costs and their incomes could be improved by adopting alternative energy technologies. The strong support for demonstrations warrants funding a highly-visible project in each subregion to function as a technical assistance and resource center for the development district. The commission recommends joint Federal and state funding, the establishment of energy committees or councils with an energy director in each district, the development of a service package, and educational training and tools made available for each district. (DCK)

9227 Alcohol Fuels and the Energy Security Act. Washington, DC; US National Alcohol Fuels Commission (1980). 46p.

This document provides a general outline of the provisions of the Energy Security Act which pertain to alcohol fuels and biomass projects. Persons or firms interested in possible federal financial assistance in these areas will find this pamphlet useful. Discussed are: alcohol fuels financial assistance; municipal waste-to-energy; research development and technical assistance provisions; alcohol fuel use and regulatory provisions; and alcohol fuels from non-biomass feedstocks. (DMC)

9228 **Renewable energy system for developing countries.** Allison, H.J. (Oklahoma State Univ., Stillwater). pp 1475-1479 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Decentralized power systems which operate from renewable energy resources can supply reliable energy to remote areas of the developing nations of the world. Such systems can do much to improve the quality of life for millions of people throughout the world. An energy system which integrates solar, wind, and biomass resources in a manner which produces a more flexible and reliable power source than could be made available from separate uses of these renewable resources is described. Prototype systems based on the concepts described are planned for Sri Lanka, Senegal, and Mexico.

9229 **Energy systems based on local renewable energy resources for a rural community in a developing country.** Cavard, D.; Criqui, P. (Institut Economique et Juridique de l'Energie, Grenoble, France). pp 1485-1489 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The application of an energy balance to a particular case, an isolated, rural developing community - the island of Marie Galante (French West Indies) - shows the following relevant facts: (1) a relatively great actual importance and a large potentiality of the renewable energy sources, which could solve certain problems of development, (2) in general present energy needs remain largely unsatisfied, and (3) the increase of the consumption of imported energy resources (mainly oil products) might cause some socio-economic desequilibria in the island. From this analysis one can draw a conclusion: it will be advantageous for such a country to develop all the biomass energy resources and the wind and photovoltaic solar sources in order to provide for the local needs of electricity and water-pumping.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

REFER ALSO TO CITATION(S) 8554, 8714

9230 **(ANL/MHD—80-11) Two-dimensional MHD generator model.** Geyer, H.K.; Ahluwalia, R.K.; Doss, E.D. (Argonne National Lab., IL (USA)). Sep 1980. Contract W-31-109-ENG-38. 103p. NTIS, PC A06/MF A01.

A steady state, two-dimensional MHD generator code, GEN, is presented. The code solves the equations of conservation of mass, momentum, and energy, using a Von Mises transformation and a local linearization of the equations. By splitting the source terms into a part proportional to the axial pressure gradient and a part independent of the gradient, the pressure distribution along the channel is easily obtained to satisfy various criteria. Thus, the code can run effectively in both design modes, where the channel geometry is determined, and analysis modes, where the geometry is previously known. The code also employs a mixing length concept for turbulent flows, Cebeci and Chang's wall roughness model, and an extension of that model to the effective thermal diffusities. Results on code validation, as well as comparisons of skin friction and Stanton number calculations with experimental results, are presented.

9231 **(DOE/ET/10815—39) Investigation of swirling flow mixing for application in an MHD pulverized coal combustor using isothermal modeling.** Power, W.H. (Tennessee Univ., Tullahoma (USA). Space Inst.). May 1980. Contract AC02-79ET10815. 80p. NTIS, PC A05/MF A01.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

The purpose of this study was to investigate combustor reactant mixing with swirling oxidizer flow. The combustor configuration that was considered was designed to simulate a 4 lbm/sec mas flow pulverized coal combustor being tested in The University of Tennessee Space Institute MHD Facility. A one-fourth dimensionally scaled combustor model was developed for isothermal flow testing. A comparison was made of cold flow tests using 3 swirler designs with a base case oxidizer injector design of perforated plated which demonstrated acceptable performance in the 4 lbm/sec MHD combustor. The three swirlers that were evaluated were designed to allow a wide range of swirl intensity to be investigated. The design criterion of the swirler was the swirl number which has been related to swirler geometry. The results of the study showed that the swirlers that were tested fell short of the mixing characteristics displayed with the perforated plate base case oxidizer injector. Test data obtained with the cold flow model established that the actual swirl numbers of two of the swirlers were much lower than the design swirl numbers. Recirculation zones were defined for all configurations that were tested, and a comparison of velocity profiles was made for the configurations.

9232 **(DOE/ET/10816—T2) MHD power generation research, development and engineering. Quarterly progress report, January to March 1980.** (Montana Energy and MHD Research and Development Inst., Inc., Butte (USA)). 1980. Contract AC07-78ET10816. 105p. NTIS, PC A06/MF A01.

Separate abstracts were prepared for progress on the ten tasks reported. (WHK)

9233 (DOE/ET/10816—T2, pp 9-20) **Creep studies on MHD preheater materials.** Kitto, K. 1980.

In MHD power generation research, development and engineering. Quarterly progress report, January to March 1980.

Several long-term compressive creep experiments were completed on Norton LS-812 spinel castable material. Tests designed to check the variation of the creep of the material and to check experimental procedures were completed with favorable results. Tests at 1400°K (2060°F) and 6 MPa (870 psi) on LS-812 resulted in secondary creep rates of 0.00052%/hr and 0.00054%/hr or a 3.8% variation. Reproducible results also were obtained for materials from two different cast batches at 1700°K (2600°F) and 1.5 MPa (220 psi). Other compressive creep tests were run between 1400 and 1738°K (2060 and 2670°F) and 0.5 and 15 MPa (70 and 2170 psi). Compressive strength measurements were made on Monofrax A, Monofrax K-3, and spinel castable materials. The strength of Monofrax A (high alumina) decreased only slightly from approximately 400 MPa (48 kpsi) at room temperature to approximately 387 MPa (56 kpsi) upon heating to 1773°K. However, Monofrax K-3 (alumina/chrome) showed a rapid decline in strength from 370 MPa at 1373°K to 140 MPa at 1773°K (53.6 psi at 2012°F to 20.3 kpsi at 2732°F). For comparison, Monofrax A and K-3 had considerably more strength at 1773°K (387 MPa and 140 MPa or 56.1 and 20.3 kpsi, respectively) than did Corhart X-317, Corhart RFG, and Monofrax E (100 MPa, 40 MPa, and 35 MPa or 14.5, 4.8, and 5.1 kpsi, respectively). The compressive strength of Norton LS-812 batches declined to less than 50% of its room temperature value upon heating to 1773°K (2732°F). Taylor 13337 spinal castable lost 50% of its strength, however, at 1437°K (2192°F) and declined to 10% of its room temperature value at 1773°K (2732°F).

9234 (DOE/ET/10816—T2, pp 21-22) **Preparation of coals for utilization in direct coal-fired MHD generation.** Rhodes, B. 1980.

In MHD power generation research, development and engineering. Quarterly progress report, January to March 1980.

This task is charged with coal preparation studies on Rosebud seam coal for utilization in direct coal-fired MHD power generation plants. Prior studies into the areas of coal preparation have led to the fluidization drying studies to generate engineering data for scale up and applications to the ETF-sized MHD units. These

experiments will measure drying rates, the equilibria between the dried coal moisture content and the off-gas humidity, heat and mass transfer coefficients, and entrainment losses for variable drying conditions. They will also include the effect of coal feed rate, inlet drying temperatures, inlet humidity, drying gas mass flow rate, and coal particle size on the preceding parameters. The data will be analyzed to show drying efficiencies while using exit gas energy from the MHD system to show the inter-relationships among the operating and design variables needed to achieve the optimum coal moisture level consistent with minimizing volatile emissions and maintaining highest coal Btu levels for MHD power generation. Progress is reported.

9235 (DOE/ET/10816—T2, pp 23-24) **Characterization of volatile matter in coal.** Beuerman, D. 1980.

In MHD power generation research, development and engineering. Quarterly progress report, January to March 1980.

Trouble-shooting of instrument problems was done this quarter. A workshop on instrument repair, trouble-shooting, and modification was attended, and the flame ionization detector (FID) was made operational. The HP capillary column was studied, and published methods of determining the organic content of atmospheres were evaluated.

9236 (DOE/ET/10816—T2, pp 25-31) **MHD materials evaluation.** Rasmussen, J.J.; Parker, R.; Morse, T.; Johnston, M. 1980.

In MHD power generation research, development and engineering. Quarterly progress report, January to March 1980.

Baseline data on pristine Monofrax A has been obtained to assist in the evaluation of changes which have taken place when this material was exposed to high temperature coal slag in the Montana State University moderate temperature slag flow facility. Thermal diffusivity measurements have been made as a function of temperature on pristine Monofrax A and Norton LS-812. Fracture toughness measurements show that the castable refractory compounds have a very low fracture toughness ($\sim$ 1 MPa $\sqrt{m}$) while the fusion-cast refractories containing a high concentration of alumina such as Monofrax A and Monofrax K-3 have significantly higher fracture toughness values ($\sim$ 3.6 MPa $\sqrt{m}$). The addition of a small amount of platinum to a stabilized ZrO_2 body had no effect on the electrical conductivity mechanism of the ZrO_2. Techniques have been developed to cut and polish the samples without structural degradation. Structural data is being obtained using optical microscopy and SEM techniques.

9237 (DOE/ET/10816—T2, pp 32-41) **Slag flow and NO/sub x/ kinetics: moderate temperature slag flow facility (MTSFF).** Townes, H.W.; Ameel, T.A. 1980.

In MHD power generation research, development and engineering. Quarterly progress report, January to March 1980.

The rebuilding of the moderate temperature slag flow facility (MTSFF) using Monofrax A as the core material was completed. The MTSFF then was operated for 750 hours total (700 hours with slag injection), and five successive cleanouts were made of deposited slag. The Monofrax A at the end of 750 hours of operation was in good condition.

9238 (DOE/ET/10816—T2, pp 42-50) **Slag-seed equilibria and separations related to the MHD system.** Howald, R. 1980.

In MHD power generation research, development and engineering. Quarterly progress report, January to March 1980.

The objective of this task is the measurement and interpretation of vapor pressures over high-temperature oxide systems and the thermo-dynamic analysis of these systems. The systems for study are primarily synthetic mixtures, actual slags, and seeded slags. The measurements are performed using atomic absorption to measure atom concentration in high-temperature graphite tube furnaces produced by diffusion from vapor pressure cells. The analysis is aimed at providing accurate equations for vapor pressure and activity in multicomponent systems for use in engineering design work wherever slags and seeded slags are encountered in the MHD systems. Efforts were directed toward completing the new computer program, finishing a manual describing the program, and applying the program to MHD calculations. The applications of the calculations are described in the paper written for the Seventh International MHD meeting which is included as Appendix A. After completing vapor pressure measurements on the four component system in December, work in this area was discontinued. (WHK)

9239 (DOE/ET/10816—T2, pp 59-63) **MHD instrumentation and data acquisition.** Johnson, R. 1980.

In MHD power generation research, development and engineering. Quarterly progress report, January to March 1980.

Several different dynamic transients involving up to 10 percent step changes in Faraday load voltage have been simulated using the combustor-nozzle-channel-diffuser program MHDTD. Results are discussed. Notched filtering of three-phase square wave power output to reduce harmonics is nearly operational. Problems with several poor silicon-controlled-rectifiers in one of the phases slightly delayed the completion of the work but has been accomplished.

9240 (DOE/ET/10816—T2, pp 69-85) **Cycle analysis and control.** Rudberg, D.A.; Pierre, D.A.; Goldsworthy, D. 1980.

In MHD power generation research, development and engineering. Quarterly progress report, January to March 1980.

Combined-cycle MHD-steam power systems are being modeled by digital computer simulations. Methods to provide efficient control of such systems are being investigated by using the simulations to ensure stable modes of response and to obtain coordinated control of many interdependent subsystems. First-principle, dynamic component models have been developed, as has a multi-input, multi-output model of the combustor, nozzle, channel, and diffuser. The component and subsystem models have been assembled into a dynamic, combined-cycle simulator of an ETF-sized plant. The system modeling is described with policies proposed for plant control.

9241 (DOE/ET/10816—T2, pp 86-95) **Slag physical properties: electrical and thermal conductivity.** Pollina, R. 1980.

In MHD power generation research, development and engineering. Quarterly progress report, January to March 1980.

The experimental measurement of the thermal expansion under load of pristine and slagged Corhart X317 firebrick was completed. The results of those measurements and some preliminary room temperature elastic modulus measurements in Carborundum Monofrax A are presented. Included as an appendix is a copy of a paper on the electrical conductivity of Rosebud coal slag accepted for presentation at the Seventh International Conference on MHD to be held at MIT in June 1980.

9242 (DOE/NASA/0107—1) **Engineering support for magnetohydrodynamic power plant analysis and design studies. Final report.** Carlson, A.W.; Chait, I.L.; Marchmont, G.; Rogali, R.; Shikar, D. (Burns and Roe, Inc., Woodbury, NY (USA)). Aug 1980. Contract AI01-77ET10769. 301p. (NASA-CR—159690). NTIS, PC A14/MF A01.

Separate abstracts were prepared for the three studies presented. The first study identifies the major factors which influence the economic engineering selection of stack inlet temperatures in combined cycle MHD powerplants and indicates the range of suitable stack inlet temperatures under typical operating conditions. The second study provides engineering data and cost estimates for four separately-fired high temperature air heater (HTAH) system designs for HTAH system thermal capacity levels of 100, 250, 500 and 1000 MW/sub t/. The third study is an engineering survey of coal drying and pulverizing equipment for MHD powerplant application and presents capital and operating cost estimates for varying degrees of coal pulverization.

9243 (DOE/NASA/0107—1, pp 1-52) **Economic engineering selection of stack inlet temperature in an MHD power plant.** Aug 1980.

In Engineering support for magnetohydrodynamic power plant analysis and design studies. Final report.

The objective of this work is to identify the major factors which influence the economic engineering selection of stack inlet temperatures for a combined cycle magnetohydrodynamic (MHD) coal-fired power plant of commercial size and to determine the

range of suitable stack inlet temperatures under typical operating conditions. The coals considered as fuel for the plant are Illinois No. 6 coal, dried to a moisture content of 2 percent, and Montana Rosebud coal dried to a moisture content of 5 percent. The stack emissions are required to meet the EPA New Source Performance Standards of June 1979. The selection of the stack gas temperature is based upon several factors related to the economic design and operation of the power plant. The major factors which are influenced by the stack gas temperature are power plant efficiency, corrosion and deposits on surfaces in contact with the gas, plume dispersion and plume visibility, and investment and operating costs. Results are reported. (WHK)

9244 (DOE/NASA/0107—1, pp 53-214) **MHD power plant high temperature air heater (HTAH) system engineering design survey and cost estimates.** Aug 1980.

In Engineering support for magnetohydrodynamic power plant analysis and design studies. Final report.

The objective of this investigation is to provide engineering data and cost estimates for four indirectly-fired high temperature air heater (HTAH) system designs based upon specified HTAH system conceptual designs. The specified designs are: (A) an oil-fired 1756°K (2700°F) air preheat temperature HTAH system, (B) an oil-fired 1922°K (3000°F) air preheat temperature HTAH system, (C) a low Btu gas-fired 1922°K (3000°F) air preheat temperature HTAH system with atmospheric combustion and (D) a low Btu gas-fired 1922°K (3000°F) air preheat temperature HTAH system with pressurized combustion. A rationale for scale up and cost estimates are presented for HTAH systems for each design for system thermal capacities of 100, 250, 500 and 1000 MW/sub t/.

9245 (DOE/NASA/0107—1, pp 215-281) **Engineering survey of coal handling and processing equipment for MHD power plant application.** Aug 1980.

In Engineering support for magnetohydrodynamic power plant analysis and design studies. Final report.

The objective of this investigation is to present technical and cost data that can be used in the evaluation and selection of coal preparation equipment applicable to an MHD power plant and to identify those parameters relating to coal properties and preparation requirements which impact on either equipment cost or performance. The work reviews data associated with 250, 500 and 1000 MW/sub t/ plant sizes and emphasizes the pulverizing, classifying and drying aspects of coal preparation. The investigation considers two coals - a high sulfur, low moisture Illinois No. 6 coal and a low sulfur, high moisture Montana Rosebud coal - pulverized to three particle sizes - 70 percent -200 mesh, 80 percent -270 mesh and 100 percent -325 mesh. A wide range of equipment is reviewed for the various preparation functions with current and near term availability. Results are detailed.

9246 **(DOE/NASA/0179—1) Analytical investigation of critical phenomena in MHD power generators.** (STD Research Corp., Arcadia, CA (USA)). 31 Jul 1980. Contract AI01-77ET10769. 375p. (NASA-CR—165143; STDR—80-22). NTIS, PC A16/MF A01.

Critical phenomena in the Arnold Engineering Development Center (AEDC) High Performance Demonstration Experiment (HPDE) and the US U-25 Experiment, are analyzed. Also analyzed are the performance of a NASA-specified 500 MW(th) flow train and computations concerning critica issues for the scale-up of MHD Generators. The HPDE is characterized by computational simulations of both the nominal conditions and the conditions during the experimental runs. The steady-state performance is discussed along with the Hall voltage overshoots during the start-up and shutdown transients. The results of simulations of the HPDE runs with codes from the Q3D and TRANSIENT code families are compared to the experimental results. The results of the simulations are in good agreement with the experimental data. Additional critica phenomena analyzed in the AEDC/HPDE are the optimal load schedules, parametric variations, the parametric dependence of the electrode voltage drops, the boundary layer behavior, near electrode phenomena with finite electrode segmentation, and current distribution in the end regions. The US U-25 experiment is characterized by computational simulations of the nominal operating conditions. The steady-state performance for the nominal design of the US U-25 experiment is analyzed, as is the dependence of performance on the mass flow rate. A NASA-specified 500 MW(th) MHD flow train is characterized for computer simulation and the electrical, transport, and thermodynamic properties at the inlet plane are analyzed. Issues for the scale-up of MHD power trains are discussed. The AEDC/HPDE performance is analyzed to compare these experimental results to scale-up rules.

9247 **(DOE/NASA/3255—1) MHD generator off-design performance and NO/sub x/ chemical kinetics analysis. Vol. I. Analysis of the off-design performance of the Engineering Test Facility (ETF) MHD generator flow train.** Wilson, D.R.; Simmons, G.A. (Texas Univ., Arlington (USA)). Jun 1980. Contract AI01-77ET10769. 81p. (NASA-CR—165187). NTIS, PC A05/MF A01.

A computer code for performing parametric design point calculations, and evaluating the off-design performance of MHD generators has been developed. A general description of the code, together with the results of a very limited study of the proposed Engineering Test Facility (ETF) MHD generator is presented in this volume. Details of the computer codes are presented in Volume II-III. The ETF study included an assessment of the effect of preheat, stoichiometry, and oxygen enrichment on the design point electrical performance of the generator, and the NO/sub x/ concentration at the exit of the radiant boiler. The off-design study included variations in mass flow rate and oxygen enrichment. Maximum design point performance was achieved with a combination of high preheat, high stoichiometry, and no oxygen enrichment. The reduction in generator power was found to scale almost quadratically with the mass flow rate reduction. The power increased to a maximum level for off-design operation at an oxygen enrichment value of 60 percent, then decreased with further increases in oxygen enrichment. The off-design generator would not run at oxygen enrichment levels less than the 50 percent design level and simultaneously match the imposed thermal power input and downstream pressure constraints. The EPA NO/sub x/ emission limit could be met in a radiant boiler length of approximately 50 meters for all but one of the design cases studied. The EPA limit was also satisfied for off-design operation involving mass flow rate reductions, however the limit was exceeded for increases in oxygen enrichment above 70 percent.

3003 Thermoelectric Generators

9248 **(AD-A—083225) High efficiency, low power thermoelectric coolers. Final report.** (Marlow Industries, Inc., Garland, TX (USA)). 1979. Contract DAAK70-78-C-0016. 129p. NTIS, PC A07/MF A01.

This report describes the work performed on a 15 month development program. The purpose of this program was the development of a high performance, multi-stage thermoelectric (TE) cooler which would operate satisfactorily under extreme military environments. Five coolers each of three types (various heat loads), were designed and fabricated. Detailed environmental and performance tests were performed on these coolers. The electrical tests included measurement of COP/stage and performance under various heat loads on each type of cooler. The effect of adding radiation shielding to each type was also determined. All of the coolers performed satisfactorily after environmental and performance testing. Performance data, predicted from design calculations and computerized material parameter measurements, showed excellent correlation with measured test data. A TE material development and evaluation program was conducted in conjunction with the cooler design and fabrication effort. P-type TE material was produced which was comparable to that commercially available. Advanced computerized TE material evaluation techniques developed by Marlow Industries were used to evaluate alpha, rho, Kappa, and Z for a particular lot of material toward the end of the program.

3004 Thermionic Converters

9249 **(AD-A—084948) Thermoelectric materials for solar energy conversion. Final report, August-December 1978.** Goff, J.F.; Lowney, J.R. (Naval Surface Weapons Center, Silver Spring, MD (USA)). 1 Feb 1979. 21p. NTIS, PC A02/MF A01.

The thermoelectric efficiency index of N-type beta-SiC has been calculated by use of the Goff-Lowney integral formulation. The scattering parameters were estimated by fitting the thermoelectric power and electrical conductivity data of Golikova, et al. The parasitic photon thermal conductivity was calculated theoretically by use of the theory of Devyatkova, et al, while the lattice thermal conductivity was treated parametrically. The results indicate that there exists an optimum carrier concentration of approximately 2 x 10^{20}/ccm and that the efficiency is still increasing at 2000K.

3005 Fuel Cells

9250 **(AD-A—083608) Definition of chemical and electrochemical properties of a fuel cell electrolyte. Interim technical report, 24 July 1978-24 December 1979.** Ahmad, J.; Foley, R.T. (American Univ., Washington, DC). Jan 1980. Contract DAAK70-77-C-0080. 70p. NTIS, PC A04/MF A01.

The present research is oriented toward the task of developing an improved electrolyte for the direct hydrocarbon-air fuel cell. The electrochemical behavior of methanesulfonic acid, ethanesulfonic acid, and sulfoacetic acid as fuel cell electrolytes was studied in a half cell at various temperatures. The rate of electro-oxidation of hydrogen at 115 degrees was very high in methanesulfonic acid and sulfoacetic acids. The rate of the electro-oxidation of propane in methanesulfonic acid at 80°C and 115°C was low. Further, there is evidence for adsorption of these acids on the platinum electrode. Sulfoacetic acid with H^2 has supported about two times higher current density than trifluoromethanesulfonic acid monohydrate, but, attempts to purify the compound were unsuccessful. It was concluded that anhydrous sulfonic acids are not good electrolytes; water solutions are required. Sulfonic acids containing unprotected C-H bonds are adsorbed on platinum and probably decompose during electrolysis. A completely substituted sulfonic acid would be the preferred electrolyte.

9251 **(DOE/ET/11303—T7) Fabrication and testing of TAA bonded carbon electrodes. Quarterly technical progress report No. 4, December 1, 1978-February 28, 1979.** Walsh, F. (ECO, Inc., Cambridge, MA (USA)). 7 Mar 1979. Contract AC03-78ET11303. 16p. NTIS, PC A02/MF A01.

A number of platinum-catalyzed cathodes have been tested in the ECO fuel cell; they have been shown to have reproducible activity which is a function of cathode thickness: improved performance with increased thickness. Preliminary data on bonded cobalt dibenzotetraazaannulene (CoTAA) catalyzed cathodes have been obtained showing them to be as active as similarly loaded (by weight) platinum-catalyzed cathodes.

9252 **(DOE/ET/25502—2) Oxygen electrodes for energy conversion and storage. Annual report II, 1 October 1978-30 September 1979.** (Diamond Shamrock Corp., Painesville, OH (USA); Case Western Reserve Univ., Cleveland, OH (USA)). 1979. Contract AC02-77ET25502. 299p. NTIS, PC A13/MF A01.

Progress is reported on the development of high performance oxygen electrodes for a spectrum of applications including industrial electrolysis, metal-air batteries and fuel cells. The research emphasizes the development of more effective electrocatalysts for both O_2 reduction and electrogeneration and the development of more effective electrode structures (particularly for O_2 cathodes) for utilizing these catalysts. It also includes the development of a predictive base to guide the search for new catalyst systems. The research has been directed principally to catalysts and electrode structures for O_2 cathodes operating on air in concentrated caustic under the conditions prevailing in membrane-type chlor-alkali cells. The replacement of the hydrogen gas generating cathodes now used in such cells with air cathodes is expected to save at least 1.0 V and is very attractive when the H_2 gas is not being used for chemical synthesis. If adopted for a substantial fraction of the chlor-alkali industry nationally, the annual electricity savings would amount to several hundred million dollars. A summary of the research results is presented, and the details of the research and results are given in the appendices, several of which have been submitted to journals for publication. (WHK)

9253 **(DOE/METC/08333—105) Hot gas cleanup for molten carbonate fuel cells. A zinc oxide reactor model, Final report.** Steinfeld, G. (Science Applications, Inc., McLean, VA (USA)). 16 Sep 1980. Contract AM21-78MC08333. 91p. NTIS, PC A05/MF A01.

Utilization of coal gasifiers to power MCFC requires a cleanup system to remove sulfur and particulates. Of the two near term options available for desulfurization of gasifier effluent, namely low temperature cleanup utilizing absorber/stripper technology, and hot gas cleanup utilizing metal oxides, there is a clear advantage to using hot gas cleanup. Since the MCFC will operate at 1200°F, and the gasifier effluent could be between 1200 to 1900°F, a hot gas cleanup system will require little or no change in process gas temperature, thereby contributing to a high overall system efficiency. A hot gas cleanup system will consist of FeO for bulk H_2S removal and ZnO for reduction of H_2S to sub ppM levels. Hot gas cleanup systems at present are not available commercially, and therefore it is the objective of this project to model the components of the system in order to help bring this technology closer to commercialization, by providing simulated operating characteristics to aid in system design, and system simulations of gasifier/MCFC systems. The modeling of the ZnO reactor is presented.

9254 **(DOE/NASA/0150—80/5) Cathode catalyst for primary phosphoric acid fuel cells. Fifth quarterly report, July-September 1980.** Walsh, F. (ECO, Inc., Cambridge, MA (USA)). 1980. Contract AI01-77ET11272. 17p. (NASA-CR—165198). NTIS, PC A02/MF A01.

Alkylation of Vulcan XC-72 has been shown to provide the most stable bond type for linking CoTAA to the surface of the carbon; this result is based on data obtained by cyclic voltammetry, pulse voltammetry and by release of 14C from bonded CoTAA. Half-cell tests at 100°C in 85% phosphoric acid have shown that CoTaa bonded to the surface of carbon (Vulcan XC-72) via an alkylation procedure is a more active catalyst than is platinum based on a factor of two improvement in Tafel slope; dimeric CoTAA has catalytic activity equal to platinum. Half-cell tests also have shown that bonded CoTAA catalysts do not suffer a loss in potential when air is used as a fuel rather than oxygen. Commercially available PTFE has been shown to be stable four months in 200°C 85% phosphoric acid based on lack of change in surface wetting properties, IR and physical characteristics. When stressed electrochemically in 150°C 85% phosphoric acid, PTFE has also shown no changes after one month.

9255 **(DOE/NASA/11272—2) Status of commercial phosphoric acid fuel cell system development.** Warshay, M.; Prokopius, P.R.; Simons, S.N.; King, R.B. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1981. Contract AI01-77ET11272. 12p. (NASA-TM—81641; CONF-810106—1). NTIS, PC A02/MF A01.

From 19. Aerospace Sciences meeting; St Louis, MO, USA (12 Jan 1981).

A review of the current commercial phosphoric acid fuel cell system technology development efforts is presented. In both the electric utility and on-site integrated energy system applications, reducing cost and increasing reliability are the technology drivers at this time. The longstanding barrier to the attainment of these goals, which manifests itself in a number of ways, has been materials. The differences in approach among the three major participants (United Technologies Corporation (UTC), Westinghouse Electric Corporation/Energy Corporation (ERC), and Engelhard Industries) and their unique technological features, including electrodes, matrices, intercell cooling, bipolar/separator plates, electrolyte management, fuel selection and system design philosophy are discussed.

9256 **(UCRL-Trans—11655) Characteristics of acidic electrolyte hydrogen-air fuel batteries (3).** Tajima, H.; Sakurai, M.; Mizukami, K.; Endo, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1980. Translation source information not available . 11p. NTIS, PC A02/MF A01.

The electrode characteristics of hydrogen-air fuel batteries using phosphoric acid as the electrolyte using hydrogen reformed

from natural gas were studied. The effects of the impurities, particularly CO, contained in the gas were examined. The effects of the carrier on poisoning of platinum by CO were studied using porous hydrogen electrodes in which carbon was used as the carrier and platinum as the catalyst. Also, the effects of the carrier on poisoning in cases where the catalyst used was a compound catalyst consisting of platinum and ruthenium, an oxidation catalyst of CO, are reported. Results are presented and discussed. (WHK)

9257 Use of fuel cells in district heating systems. Nelson, S.H.; Goldman, R.S. (Energy Syst Res Group Inc, Albany, NY). pp 498-504 of Technology for energy conservation. Silver Spring, MD; Inf. Transfer Inc. (1978).

From Technology for energy conservation; Albuquerque, NM, USA (23 Jan 1978).

Five concepts for using waste heat from phosphoric acid fuel cells in conjunction with district heating are presented. These are: provision of boiler feedwater and low pressure steam in low pressure steam systems; providing deaerator feedwater heating to either steam boilers or co-generating units; direct feedwater heating to boilers; provision of hot water. All these require either natural gas or light petroleum distillates for fuel. A brief analysis is made of potential use of phosphoric acid fuel cells on Consolidated Edison's system. 5 refs.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 9206, 9226

9258 (DOE/CS—0205) Program activities, DOE state and local assistance programs, 1980 report. (USDOE Assistant Secretary for Conservation and Solar Energy, Washington, DC. Office of State and Local Assistance Programs). Jan 1981. 29p. NTIS, PC A03/MF A01.

Progress achieved by DOE State and Local Assistance Programs during FY 1980 and since they were established is summarized. These programs enable improved energy efficiency of industry, transportation, commercial establishments, public buildings, and residences. Eight programs (State Energy Conservation, Energy Extension Service, Weatherization Assistance, Institutional Buildings Grants, Energy-Related Inventions, Appropriate Technology Small Grants, Emergency Energy Conservation, Emergency Building Temperature Restrictions) are described. They provide the impetus for thousands of individual and organizational actions that have significantly affected national energy use patterns. (MCW)

9259 (ORNL—5638) Energy Division annual progress report for period ending September 30, 1979. Fulkerson, W. (Oak Ridge National Lab., TN (USA)). Jun 1980. Contract W-7405-ENG-26. 246p. NTIS, PC A11/MF A01.

The format of this report follows approximately the organizational structure of the Energy Division, with each chapter summarizing the activities of one section of the division; a separate abstract was prepared for each of the six chapters. The executive summary of this report, however - in order to give the reader a more-unified and coherent overview of the whole division - was organized into five major topic areas: (1) Analysis and Assessment; (2) Conservation, Solar, and Renewable Energy Technology Development; (3) Energy Models and Data; (4) Emergency Technology and Civil Defense; and (5) Research Utilization. A final part of the report, Presentation of Research Results, lists the following: awards and professional activities; publications; subcontractor publications; student papers and theses; oral presentations; workshops and conferences organized by Energy Division staff; Advisory Committee; seminar speakers; Energy Division subcontractors by company; and patent applications.

9260 Proceedings of the national conference on technology for energy conservation, 3rd, 1979. Silver Spring, MD; Inf. Transfer Inc. (1979). 626p. (CONF-790107—).

From 3. national conference and exhibition on technology for energy conservation; Tucson, AZ, USA (22 Jan 1979).

This conference contains 111 papers, 108 of which are abstracted separately. The primary areas discussed include energy management, residential energy conservation, solar energy, combination energy systems (advanced concepts), energy education, bioconversion, economics, and codes.

3201 Buildings

REFER ALSO TO CITATION(S) 8841, 8904, 8911, 8915, 8916, 8919, 8926, 8930, 8952, 8954, 8997, 9182, 9207, 9208, 9527

9261 (AD-A—082737) Building insulation materials compilation. Final report. Bourne, J.G.; Brownell, D.L.; Guyer, E.C.; Thompson, R.G.; Tye, R.P. (Dynatech R/D Co., Cambridge, MA (USA)). Sep 1979. Contract N68305-79-C-0008. 139p. NTIS, PC A07/MF A01.

This document is intended to provide a ready source of the thermal characteristics, availability, safety, and other pertinent information for the selected types of insulation. The compilation covers all commonly used types of products whose primary purpose is to provide thermal resistance to heat flow through the building envelope. Due to the importance of controlling the migration of moisture to the insulating material, vapor barriers are also presented. Where possible the generic properties of a particular insulating material are presented to allow the designer to draw comparisons between types. In addition, where data are available, the variation of conductivity with temperature and/or density is given for each generic material.

9262 (AD-A—085298) An analysis of electrical consumption at representative army installations. Interim report. Windingland, L.M. (Army Construction Engineering Research Lab., Champaign, IL (USA)). May 1980. 81p. NTIS, PC A05/MF A01.

This report describes analysis of monthly and daily electrical energy consumption data collected over 2 years from 8 electrical feeders at Fort Carson CO, and 20 different Army buildings at Fort Carson and at Fort Belvoir, VA. The work was conducted to determine why electrical energy consumption has been increasing at Army installations, and to provide a basis for determining methods to reduce consumption. It was determined that many Army buildings have a high minimum electrical usage (minimum demand) that amounts to up to 75 percent of total annual consumption. Tables and graphs are provided which amplify the significance of this minimum demand. It was concluded that a shift from emphasizing a reduction in occupant usage of electrical energy to a concentrated effort to minimize the continuous electrical usage caused by building operation and heating, ventilating, and air-conditioning (HVAC) systems should reduce electrical consumption at Army installations.

9263 (ANL/EES-TM—96(Vol.2), pp 101-115) **Economic analysis of potential impact of watersaving toilets.** Cole, C.A.; Buskirk, E.D. Jr.; Franz, W. (Pennsylvania State Univ., Middletown). Aug 1980.

From 12. IECEC conference on energy conservation in the treatment of industrial wastewaters; New Orleans, LA, USA (10 Dec 1979).

The potential flow reductions and economic benefits of energy and chemical savings in water conservation for some communities in Pennsylvania are addressed. Actual reductions in water consumption were investigated using a matched set of residences, those that had watersaving toilets and those that did not. The energy and chemical usage reductions were then projected based upon an assumed level of adoption of the water-saving toilets. It is shown that for the Springettsbury Township, specifically, water conserving toilets in new residences are playing an important role in reducing long-term water usage. Toilet device inserts used for retrofit could not be evaluated because of the poor maintenance and performance. (MCW)

9264 (CONF-800419—(Vol.2), pp 652-666) **Diesel engine advances: development and use of a spray combustion modeling to predict diesel engine efficiency and pollutant emissions.** Hiroyasu, H.; Arai, M. (Univ. of Hiroshima, Japan). Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

A multi-zone model of diesel spray combustion in direct-injection diesel engines was developed for studies of the effects of variations in performance, efficiency, and pollutant formation. By considering the complete air-fuel jet mixing process and temperature in each zone, the model also enables subsequent spacial and temporal history of burning rate, local temperature, and air-fuel ratio, etc., to be calculated. From this information, the simulation computes engine power, fuel consumption, NO emissions, and soot masses. An extensive parametric investigation of the effects of changes in engine design and operating variables on engine specific fuel consumption, NOx emissions, and soot masses were carried out. Variables studied were: injection timing, engine speed, fuel amount, fuel injection rate, fuel injection duration, swirl ratio, droplet size, and spray velocity. The model is described, along with a discussion of the programs formulated. The validity of this model was examined by comparing predictions made with the simulation with data from a direct injection single-cylinder engine over a range of injection timings, engine speeds, fuel amounts, and swirling ratios. Predicted engine performance and pollutant emissions showed acceptable quantitative agreement with the data. (LCL)

9265 (CONF-800995—, pp 55-62) **Earth sheltered buildings: construction activity and research in the US.** Sterling, R.L. (Underground Space Center, Minneapolis, MN). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The following are discussed: recent construction, research and information, and government programs. (MHR)

9266 (CONF-800995—, pp 63-64) **Affordable, earth sheltered, passive solar house.** Marcum, D.S. (Hobbittat, Inc., Lexington, KY). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

A 2700 square foot, two-story house incorporating earth shelter and passive solar heating techniques is discussed. The house has a conventional roof. Auxiliary heating is a wood stove. (MHR)

9267 (CONF-800995—, pp 65-71) **Waterproofing the earth sheltered building.** von Fraunhoffer, H.J. (CONCEPT 2000, Inc., Phoenix, AZ). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The following subjects are discussed: the need for waterproofing, where water-proofing is required, types of waterproofing, installation methods, cost, water testing, backfilling, and product information. (MHR)

9268 (CONF-800995—, pp 73-79) **Earth shelter experience of codes, zoning ordinances, financing, incentives and attitudes.** Scott, D.M. (Washington State Univ., Pullman). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The following subjects are discussed: fire egress, natural light and ventilation, guard rails, habitability of low grade space, structural design, waterproofing, energy, financing, and incentives. Experiences with earth sheltered buildings are reviewed. (MHR)

9269 (CONF-800995—, pp 115-123) **Solar energy and conservation in other lands.** Yellott, J.I. (Arizona State Univ., Tempe). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

World population is discussed by latitutde and consumption of fossil fuels. Solar and energy conservation activities are reviewed for Denmark, France, Germany, Finland, Japan, and the United Kingdom. (MHR)

9270 (CONF-800995—, pp 133-137) **Solar/conservation remodel for Seattle.** Baylon, D. (Ecotope Group, Seattle, WA). 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

The experiences involved in remodeling an older home are reviewed. Problems are discussed concerning design, building codes, financing, materials delivery, and labor. The final product is a well-insulated house with a greenhouse roof on the third story, rock bin storage, and wood auxiliary heating system. (MHR)

9271 (CONF-800995—, pp 233-242) **Roggasch house: passive solar design using a standard 6000 Btu heat loss for surface area.** Roggasch, R. 1980.

From Western SUN 1980 solar update conference; Salt Lake City, UT, USA (24 Sep 1980).

A 1700 ft^2 house in Fairbanks, Alaska with an R-value of 64 is described. The thermal insulation is such that the house may be heated with a 1500 watt electric heater at a cost of less than $200 per year. Problems with ventilation and humidity and plans to add some solar heating are discussed. Tables of heat losses per degree day and R-value and Btu losses per square feet for various materials are included. (MHR)

9272 **(CONF-810101—3) Computer model for air-cooled refrigerant condensers with specified refrigerant circuiting.** Ellison, R.D.; Creswick, F.A.; Fischer, S.K.; Jackson, W.L. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01.

From American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) meeting; Chicago, IL, USA (25 Jan 1981).

A computer model for an air-cooled refrigerant condensor is presented; the model is intended for use in detailed design analyses or in simulation of the performance of existing heat exchangers that have complex refrigerant circuiting or unusual air-side geometries. The model relies on a tube-by-tube computational approach calculating the thermal and fluid-flow performance of each tube in the heat exchanger individually, using local temperatures and heat transfer coefficients. The refrigerant circuiting must be specified; the joining or branching of parallel circuits is accommodated using appropriate mixing expressions. Air-side heat exchange correlations may be specified so that various surface geometries can be investigated. Results of the analyses of two condensers are compared to experiment.

9273 **(CONF-810101—4) Ice-maker heat pump harvesting scheme development and ice-packing density.** Baxter, V.D. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 26p. NTIS, PC A03/MF A01.

From American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) meeting; Chicago, IL, USA (25 Jan 1981).

Three harvest schemes were tested: hot-gas, stored-refrigerant, and dual-fluid off-cycle. The hot-gas scheme tended to penalize excessively the heating output of the system. Stored-refrigerant schemes eliminated that problem but caused compressor failures due to floodback and oil dilution. The dual-fluid schemes exhibited no such problems and demonstrated an ability to harvest during compressor off-cycles. Therefore, it is concluded that dual-fluid off-cycle schemes are the best for use with IMHPs using hermetic compressors. Ice-packing density measurements indicate a maximum packing factor for plate ice from IMHPs of 0.4 compared to 0.8 for brine-chiller systems. Having the ice distributed evenly in water was found to give better packing factors than allowing it to pile up under the plates. A survey of commercial ice makers indicates that IMHPs producing cylindrical or cubical ice rather than sheets would have packing factors of 0.58 to 0.66 with obvious economic benefits. However, the cost of evaporators for making such ice is likely to offset those benefits. Larger storage bin requirements make plate-type IMHP systems significantly more expensive than brine-chiller systems in most cases.

9274 **(CONF-810101—5) Design optimization of conventional heat pumps: application to steady-state heating efficiency.** Rice, C.K.; Fischer, S.K.; Ellison, R.D.; Jackson, W.L. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 28p. NTIS, PC A03/MF A01.

From American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) meeting; Chicago, IL, USA (25 Jan 1981).

A physically-based heat pump model was connected to an optimiztion program to form a computer code for use in the design of high-efficiency heat pumps. The method used allows for the si-

multaneous optimization of selected design variables, taking proper account of their interactions, while constraining other parameters to chosen limits or fixed values. For optimiztion of the steady-state heating efficiency of conventional heat pumps, ten variables were optimized while heating capacity was fixed; the results may, however, be scaled to other capacities. Calculations were made for a range of component efficiencies and heat exchanger sizes. The results predict substantial improvement in heating performance due to both optimal system configurations and the use of improved components. Sensitivity analyses show that there is considerable latitude for deviating from the optimum design to make use of available component sizes and for accomodating the compromises needed for good cooling performance.

9275 **(COO—2911-7) Development and demonstration of a Stirling/Rankine heat activated heat pump. Semi-annual report, January-June 1980.** (General Electric Co., Philadelphia, PA (USA). Valley Forge Space Center). 1980. Contract AC02-77CS20043. 108p. NTIS, PC A06/MF A01.

Progress on development of the gas heat pump is reported. Concentrated effort on the integrated testing of the combustor/engine/compressor assembly in the integrated test stand is described. Data from the integrated test were reduced and analyzed and performance improvement modifications were made and tested. Additional component tests were performed on the compressor, air handler units, and combustor in parallel with integrated testing. Development work continued on the alternate engine starter design options, seal and bearing life, and transient load acceptance. Major system development accomplishments on the combustor, engine, compressor, controls, and air handlers are described in detail. Detailed descriptions of the program progress on each subsystem, overall product design, and all other related program areas are presented. (MCW)

9276 **(DOE/CS—0194) Expansion of the residential conservation service program to multi-family and small commercial buildings.** (Oak Ridge National Lab., TN (USA)). Nov 1980. Contract W-7405-ENG-26. 193p. NTIS, PC A09/MF A01.

Alternative regulatory provisions are considered which might permit achievement of the building energy conservation regulatory goals at a lower cost. Major issues, regulatory and legislative options, and cost-benefit analyses are discussed for multi-family and commercial buildings. The following are presented: related government programs, urban and community impact analysis, institutional impacts, energy cost, Residential Conservation Service coverage, methods of analysis, and regional studies. (MHR)

9277 **(DOE/CS/20057—T2) Parallel calculations between the TC 4.7 simplified energy calculation procedure and seven comprehensive hourly simulation energy calculation procedures.** Kusuda, T. (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., New York). 31 Oct 1980. Contract AC01-78CS20057. 16p. NTIS, PC A02/MF A01.

The TC 4.7 simplified energy calculation method is a bin method used by the REAP procedure of the Carrier Corporation, except for the load estimating calculations. The simplified procedure was compared with hourly simulation procedures for an office building in Washington, DC. The comparison studied the extent as well as the reasons for agreement and discrepancies due to these two different types of annual energy analysis (bin method and hourly simulation methods). Results of the parallel calculations are discussed and the major reasons of discrepancies between the hourly simulation technique and the simplified TC 4.7 method are identified. Data resulting from the calculation methods are tabulated. (MCW)

9278 **(DOE/CS/20060—5120(Exec.Summ.)) Groundwater heat pumps: an examination of hydrogeologic, environmental, legal, and economic factors affecting their use.** Armitage, D.M.; Bacon, D.J.; Massey-Norton, J.T.; Miller, J.M. (National Water Well Association, Worthington, OH (USA)). 12 Nov 1980. Contract AC01-78CS20060. 26p. NTIS, PC A03/MF A01.

Factors affecting the use of ground water (well) are presented. First is the well cost and the availability of an adequate supply of suitable quality of well water. Second, the removal of significant quantities of well water without suitable recharge may deplete the underground aquifer. Plans to reinject or return the water underground may be precluded by legal restrictions. It could entail additional costs for the disposal well. Special provisions to prevent thermal alterations of the underground source may be required. These issues are addressed in the study and other questions are answered relating to ground-water quality and availability, potential environmental effects, legal restrictions, and energy use and economics of ground-water heat pump use. The main elements of the study and conclusions are summarized. Other topics briefly discussed are: ground-water resources in the US; water-source heat pump equipment; and energy use comparisons. Some data on heat pump use in Atlanta, Birmingham, Cleveland, Columbus, Concord, Houston, Philadelphia, Seattle, and Tulsa are tabulated and graphically presented. Data of ground water heat pump water use and effluent disposal regulations by states are summarized.

9279 **(DOE/EIA—0261) Residential energy demand models: current status and future improvements.** Peabody, G. (Department of Energy, Washington, DC (USA). Office of Energy Use Analysis). Dec 1980. 67p. NTIS, PC A04/MF A01.

Two models that EIA currently uses to analyze energy use by the residential sector are described. One model, developed at ORNL and termed the ORNL model, is used to forecast energy use by fuel type for various end-uses on a yearly basis. The second is the MATH/CHRDS which is used to analyze variations in energy expenditures by households of various socioeconomic and demographic characteristics. It was developed by Mathematica Policy Research, Inc. Also discussed is a proposal for a new model. In the new model, the essential features of the ORNL and MATH/CHRDS model are retained and integrated into a framework that is more flexible than either model. The important determinants of energy use by households are reviewed.

9280 **(DOE/R5/10130—2) Sunspace Minnesota: passive solar design for winter resorts. Period covered, August 1979-October 1980.** Johnson, J.M. (Johnson (Jay M.), Excelsior, MN (USA)). 1980. Contract FG02-79R510130. 50p. NTIS, PC A03/MF A01.

Minnesota winter resorts are discussed as to type, size, and use. Energy needs and conservation techniques are described by cabin type and problem areas. Existing cabins are analyzed for conservation opportunities and solar retrofit potential. New cabin designs and concepts are presented including earth sheltered buildings. (MHR)

9281 **(EPRI-EM—1680) Commercial solar/load management experiment: new mechanical engineering building.** Noble, J.M.; Nesmith, T. (Public Service Co. of New Mexico, Albuquerque (USA)). Jan 1981. 35p. NTIS, PC A03/MF A01.

The effects of load management heat recovery, thermal storage, and solar systems on energy usage and power demand profiles in the University of New Mexico's Mechanical Engineering Building are presented, studied via two-year monitoring of the building's heating and cooling systems and recording of sensor signals by a computer-based data acquisition system. A modified AXCESS Energy Analysis Program to simulate building energy usage is detailed, and the development of preferred strategies for maximizing the building's load management capabilities is outlined.

9282 **(LBL—10514) Cost effectiveness of visibility-based design procedures for general office lighting.** Clear, R.; Berman, S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1980. Contract W-7405-ENG-48. 41p. NTIS, PC A03/MF A01.

General office lighting visibility specifications were analyzed with respect to optimization of cost effectiveness. Cost effectiveness is a function of visual performance, not visibility per se. It was found that the present procedures which utilize Equivalent Spherical Illumination are not readily adaptible to cost optimization calculations. An alternative procedure using log visibility level is derived which appears suitable for this use. A sample calculation of net benefits versus light level is presented. For the sample calculation

the net benefits from visibility saturate at lower levels of visibility than are normally prescribed for office environments.

9283 (NBS-Handbook—135) Life-cycle costing manual for the Federal energy management program: a guide for evaluating the cost effectiveness of energy conservation and renewable energy projects for new and existing Federally owned and leased buildings and facilities. Final report. Ruegg, R.T. (National Engineering Lab. (NBS), Washington, DC (USA)). Dec 1980. Contract AI01-77CS20460. 243p. NTIS, PC A11/MF A01.

This manual is a guide to understanding the life-cycle costing method and an aid to calculating the measures required for evaluating energy conservation and renewable energy investments in all Federal buildings. It expands upon life-cycle costing criteria contained in the Program Rules of the Federal Energy Management Program (Subpart A of Part 436, Title 10, US Code of Federal Regulations) and is consistent with those criteria. Its purpose is to facilitate the implementation of the Program Rules by explaining the life-cycle costing method, defining the measures, describing the assumptions and procedures to follow in performing evaluations, and giving examples. It provides worksheets, a computer program, and instructions for calculating the required measurements. The life-cycle costing method and evaluation procedures set forth in the Federal Energy Management Program Rules and described in greater detail in this guide are to be followed by all Federal agencies for all energy conservation and renewable energy projects undertaken in new and existing buildings and facilities owned or leased by the Federal government, unless specifically exempted. The establishment of the methods and procedures and their use by Federal agencies to evaluate energy conservation and solar energy investments are required by Section 381(a) (2) of the Energy Policy and Conservation Act, as amended, 42 U.S.C. 6361 (a) (2); Section 10 of Presidential Executive Order 11912, amended; and by Title V of the National Energy Conservation Policy Act, 92 Stat. 3275.

9284 (NP—24982) Economic and technical possibilities for energy conservation through the introduction of comprehensive use-oriented heat cost calculations. Leberling, H. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Inst. fuer Wirtschaftswissenschaften). 1979. 167p. (In German). NTIS (US Sales Only), PC A08/MF A01.

The most significant energy use sector, private households and small businesses, uses about 45% of the total end-use energy in West Germany. Of this about 82% is for heating energy. Therefore, nearly 40% of the end-use energy is used for the heating of dwellings. Presented here is a different basis for energy policy measures. Along with the need for lower heating of buildings, currently the impression is growing that the method for making heating cost calculations has an influence on heating energy use. Methods of flat-rate heating cost calculations or heat payments in use today do not reflect actual heat energy consumption. The affected user will, in this case, not be motivated to saving, but, as experience shows, to increased energy waste. The basis for these relationships are found, among other things, in that the savings on the basis of the calculation method are equally divided among the users. As numerical statistics confirm, heating energy use decreases approximately on an average of 20% when heating costs are calculated according to actual consumption in comparison with flat-rate cost calculations. Continuing investigations by the Wolfburg city utilities now show that heat energy savings in the coarse of time are climbing at a rate over 20%. It remains to be determined, using careful observation methods, whether a savings of 15 to 20% in heating energy can be expected without noticeable comfort loss.

9285 (ORNL/Sub—7381/1) Research and development of a high efficiency gas-fired water heater. Volume 1. Final report summary. Vasilakis, A.D.; Pearson, J.F.; Gerstmann, J. (Advanced Mechanical Technology, Inc., Newton, MA (USA)). May 1980. Contract W-7405-ENG-26. 40p. NTIS, PC A03/MF A01.

A summary of the work performed to design and develop a cost-effective high efficiency gas-fired water heater is presented. Details on the project plan showing the allocation of financial and personnel resources, the technical approach, the timing of principal events, decision, and milestones are described (Task 1). Studies necessary to determine the marketability of the high efficiency heaters in the residential sector are performed for Task 2. The necessary work to develop, fabricate, and test a prototype unit as specified in Task 2 is identified in Task 3. Test and evaluation specifications are also identified in Task 3. Task 4 consists of preparing the project plan for the production and field demonstration of the gas-fired water heater. (MCW)

9286 (ORNL/Sub—7381/2) Research and development of a high efficiency gas-fired water heater. Volume 2. Task reports. Vasilakis, A.D.; Pearson, J.F.; Gerstmann, J. (Advanced Mechanical Technology, Inc., Newton, MA (USA)). Jan 1980. Contract W-7405-ENG-26. 237p. NTIS, PC A11/MF A01.

Design and development of a cost-effective high efficiency gas-fired water heater to attain a service efficiency of 70% (including the effect of exfiltration) and a service efficiency of 78% (excluding exfiltration) for a 75 GPD draw at a 90°F temperature rise, with a stored water to conditioned air temperature difference of 80°F, are described in detail. Based on concept evaluation, a non-powered natural draft water heater was chosen as the most cost-effective design to develop. The projected installed cost is $374 compared to $200 for a conventional unit. When the project water heater is compared to a conventional unit, it has a payback of 3.7 years and life cycle savings of $350 to the consumer. A prototype water heater was designed, constructed, and tested. When operated with sealed combustion, the unit has a service efficiency of 66.4% (including the effect of exfiltration) below a burner input of 32,000 Btu/h. In the open combustion configuration, the unit operated at a measured efficiency of 66.4% Btu/h (excluding exfiltration). This compares with a service efficiency of 51.3% for a conventional water heater and 61% for a conventional high efficiency unit capable of meeting ASHRAE 90-75. Operational tests showed the unit performed well with no evidence of stacking or hot spots. It met or exceeded all capacity or usage tests specified in the program test plan and met all emission goals. Future work will concentrate on designing, building, and testing pre-production units. It is anticipated that both sealed combustion and open draft models will be pursued.

9287 Energy use in Minnesota institutional buildings. Hirst, E. (Oak Ridge National Lab., TN); Hermans, R.; Eastes, C. *Energy Systems and Policy (U.S.);* **4**: No. 4, 295-315(1980).

This paper describes the contents and analyzes the results of data on energy use and building characteristics for institutional buildings in Minnesota. A total of 1,952 public schools, hospitals, local government buildings, and public-care institutions constitutes the data set examined here. Total annual energy use in the buildings eligible for Federal and state institutional buildings grants programs is 72 trillion Btu, of which almost two-thirds is fossil fuel. The annual cost of fossil fuels and electricity for these buildings is almost $200 million. Regression equations are developed to explain variations in energy use among these buildings. These equations include floor space, year of construction, fuel prices, occupancy, fraction of floor space air-conditioned, building type, and heating-fuel type as independent variables. They should be useful in allocating funds to conduct audits at these buildings. 12 references, 1 figure, 6 tables.

9288 Simplified energy design economics: principles of economics applied to energy conservation and solar energy investments in buildings. Marshall, H.E.; Ruegg, R.T. Washington, DC; National Bureau of Standards (1980). 55p. (NBS-Special Pub—544). GPO $3.50.

A guide to basic economic concepts and tools for solving simple economic problems in energy conservation and for understanding complex problems is provided. The concepts of economic efficiency are discussed, followed by a discussion of the basic principles of economics required to comprehend the economic evaluations of alternative investment decisions. Step-by-step procedures for evaluating the economic desirability of alternative investments are presented to illustrate and reinforce an understanding of the principles. Five tools of economic analysis discussed are: life-cycle cost, net benefits or savings, savings-to-investment ratio, internal rate of return, and discounted payback. A solar energy system with

a conventional backup system is evaluated for cost effectiveness against a conventional energy system used alone using the five tools. Factors affecting benefits and costs discussed are: discount rate, incentives, inflation, salvage value, taxes, time horizon, and uncertainty. A glossary, discount formulas and factors, and uniform present worth factors modified for energy price escalation are covered in appendices. (MCW)

9289 **Energy conservation in buildings: an economics guidebook for investment decisions.** Marshall, H.E.; Ruegg, R.T. Washington, DC; National Bureau of Standards (1980). 153p. (NBS-Handbook—132). GPO $5.00.

This guidebook provides principles, techniques, step-by-step illustrations, and sample problems on how to evaluate the economics of energy conservation and solar energy investments. Techniques of economic evaluation including life-cycle costing, net benefits, savings-to-investment ratio, internal rate-of-return, and discounted payback analyses are described and compared in terms of their advantages and disadvantages. Discounting, a procedure for taking into account the time value of money, is illustrated in the analysis of an investment in heat pumps. Practice problems for discounting and for applying each of the five techniques are presented. Factors that affect benefits and costs, including time horizons, discount rates, inflation, incentives, taxes, salvage values, and measures of uncertainty, are discussed, and guidance is provided for selecting appropriate values for these factors when making economic evaluations. Comprehensive case illustrations for solar heating and for window design management are described. Appendices provide tables and formulas for evaluating the economics of alternative conservation investments.

9290 **Natural heating and cooling of some traditional Mexican dwellings.** Hernandez, E.; Rivera, M. (Universidad Nacional Autonoma de Mexico, Mexico City). pp 1526-1529 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Due to the great variety of climates in Mexico, several types of traditional dwellings have been developed along the country in the last centuries. A description of the main characteristics of the heating, cooling, and ventilation methods used in these dwellings are described. Several types of climates involved are studied such as: tropical rainy with no cool season, steppe, desert and middle latitude rainy with mild winters (highland climates). Most of these dwellings have very ingenious and interesting shapes and structures allowing to achieve the thermal comfort of the occupants. A study of the thermal properties of the local materials involved are also discussed. Based on the traditional habitat concepts important design features may be suggested for present constructions in order to guarantee a reasonable thermal comfort in living spaces.

9291 **Physical modeling of buildings.** Hassan, K.E. (Centre for Solar Energy Studies, Tripoli, Libya); Zaki, G.M.; El-Shibani, A.A. pp 1551-1555 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The problems of simulating the thermal behavior of a building by a scale model is discussed. It takes into consideration insolation on and into the building, and the energy that may be removed by a solar device. The similarity groups that control modeling are deduced from the governing mathematical relations. The effect of each of these groups is studied in some detail.

9292 **Light selective structures for large scale natural air conditioning.** Addeo, A. (MONTEDISON/DIRS, Naples, Italy); Nicolais, L.; Romeo, G.; Bartoli, B.; Coluzzi, B.; Silvestrini, V. pp 1660-1664 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Natural radiative cooling of selective surfaces exposed to clear nocturnal sky has already been shown to be of interest for some applications like the cooling of warehouses. Results on the temperature condition of large areas, obtained with cheap selective covers capable of radiative cooling even during the day, are reported.

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9293 **(AD-A—082754) Thermal response turbine shroud. Final report, 26 September 1978-28 September 1979.** Gay, C.H. (General Electric Co., Cincinnati, OH (USA)). Nov 1979. Contract F33615-78-C-2071. 149p. NTIS, PC A07/MF A01.

The Thermal Response Turbine Shroud program studied and evaluated overall engine active clearance control designs and payoffs for a broad range of engine/aircraft combinations. Both turbine and compressor active clearance control systems were considered for gas turbine engines that encompassed high and low fan bypass ratios, single and two stage turbines, and commercial and military missions. The study of active clearance control included detailed material, heat transfer and thermal and mechanical growth analyses. The study effort looked at the active control of clearance at transient as well as steady state engine operation. The evaluation included an overall assessment of active clearance control benefits and penalties in both performance and cost for the particular aircraft/engine system studied.

9294 **(AD-A—082825) Urban traffic signal control for fuel economy.** Messenger, G.S.; Richardson, D.B.; Graefe, P.W.U.; Mufti, I.H. (National Research Council of Canada, Ottawa, Ontario). Jan 1980. 44p. NTIS, PC A03/MF A01.

A study was made to determine the influence of two computer-controlled traffic signal timing plans over a given route. The two plans are the existing plan based on SIGRID (Signal GRId Design program) and TRANSYT (Traffic Network Study Tool). The results show that under the TRANSYT timing plan, vehicles encountered fewer stops, saved time and used a slightly smaller amount of fuel than under the existing timing plan. Vehicle fuel consumption was computed using a computer model of a vehicle which used velocity profiles obtained from an instrumented 'floating' car. Single and multiple linear regression analyses were used to determine the relationship between the fuel consumption and the relatively easy-to-measure and statistically stable quantities such as trip time, number of stops and delay time. It was found that fuel consumption could be expressed adequately as a linear combination of trip time, number of stops and delay time. Using only two independent variables showed a combination of delay time and stops to be equally as good as a combination of travel time and stops. When restricted to a single independent variable, any one of them could be used for predicting fuel consumption.

9295 **(AD-A—082833) Quarterly bulletin of the Division of Mechanical Engineering and the National Aeronautical Establishment, Ottawa, 1 October to 31 December 1979.** (National Research Council of Canada, Ottawa, Ontario). 1979. 88p. NTIS, PC A05/MF A01.

The following topics are discussed: NAE Convair 580 Aeromagnetics Program; Urban Traffic Signal Control for Fuel Economy; and Current Projects of the Division of Mechanical Engineering and the National Aeronautical Establishment.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 8558, 8675, 8841, 9097, 9188, 9503

9296 **(AD-A—083317) Densified biomass as an alternative army heating and power plant fuel. Final report.** Hathaway, S.A.; Lin, J.S.; Mahon, D.; Magrino, T.; Duster, K. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Mar 1980. 87p. NTIS, PC A05/MF A01.

This investigation evaluated the technical and economic potential of using densified biomass (principally wood pellets) as a coal substitute in Army heating and power plants. The report reviews Department of Defense (DOD) experience with and tests of wood pellets; production of wood pellets (excluding silvicultural as-

pects); handling, storing, and feeding; combustion; major environmental considerations; and economics of use.

9297 (ANL/OEPM—80-3) Survey of electrochemical production of inorganic compounds. Final report. (Castle Technology Corp., Lexington, MA (USA)). Oct 1980. Contract W-31-109-ENG-38. 149p. NTIS, PC A07/MF A01.

The electrochemical generation of inorganic compounds, excluding chlorine/caustic, has been critically reviewed. About 60 x 10^{12} Btu/y fossil fuel equivalent will be used in the year 2000 for the electrosynthesis of inorganic compounds. Significant energy savings in chlorate production can result from the development of suitable electrocatalysts for lowering the cathodic overpotential. Perchlorates, electrolytic hypochlorite, electrolytic manganese dioxide, fluorine and other miscellaneous compounds use relatively small amounts of electrical energy. Implementation of caustic scrubber technology for stack gas cleanup would result in appreciable amounts of sodium sulfate which could be electrolyzed to regenerate caustic. Hydrogen peroxide, now produced by the alkyl anthraquinone process, could be made electrolytically by a new process coupling anodic oxidation of sulfate with cathodic reduction of oxygen in alkaline solution. Ozone is currently manufactured using energy-inefficient silent discharge equipment. A novel energy-efficient approach which uses an oxygen-enhanced anodic reaction is examined.

9298 (CONF-791108—27) Computer model of a transversal flow press nip. Jewett, K.B.; Ceckler, W.H.; Busker, L.H.; Co, A. (Maine Univ., Orono (USA)). 1979. Contract AS02-78CS40064. 36p. NTIS, PC A03/MF A01.

From 72. AICHE meeting; San Francisco, CA, USA (25 Nov 1979).

A computer model which simulates wet pressing of paper in a transversal flow press nip is presented. The model encompasses two-phase flow of air and water through a compressible cellulose mat. Provisions are made for the effects of both dynamic compression and capillary pressure differences between paper and felt. Preliminary predictions of the model are presented and practical calculational problems are discussed.

9299 (DOE/CS/20028—T1) Potential products from North Dakota lignite fly ash. Final report. Anderson, G.R. (Energy Development Board of Mercer County, Hazen, ND (USA)). Jun 1980. Contract FG03-78CS20028. 82p. NTIS, PC A05/MF A01.

Four major areas where fly ash can be used are explored. Concrete building blocks with fly ash replacing 50% of the portland cement have proven to be successful using current ASTM standards. Results in the ceramics area show that a ceramic-like product using fly ash and crushed glass with a small amount of clay as a green binder. Some preliminary results using sulfur ash in building materials are reported and with results of making wallboard from ash. (MHR)

9300 (DOE/CS/40012—2) High temperature range recuperator. Phase II. Prototype demonstration and material and analytical studies. Final report. (Terra Tek, Inc., Salt Lake City, UT (USA)). Apr 1980. Contract AC07-77CS40012. 530p. NTIS, PC A23/MF A01.

A summary of the work performed to fully evaluate the commercial potential of a unique ceramic recuperator for use in recovering waste heat from high temperature furnace exhaust gases is presented. The recuperator concept being developed consists of a vertical cylindrical heat exchange column formed from modular sections. Within the column, the gasketed modules form two helical flow passages - one for high temperature exhaust gases and one for pre-heating combustion air. The column is operated in a counterflow mode, with the exhaust gas entering at the bottom and the combustion air entering at the top of the column. Activities included design and procurement of prototype recuperator modules, construction and testing of two prototype recuperator assemblies, exposure and mechanical properties testing of candidate materials, structural analysis of the modules, and assessment of the economic viability of the concept. The results of the project indicated that the proposed recuperator concept was feasible from a technical standpoint. Economic analysis based upon recuperator performance characteristics and module manufacturing costs defined during the program indicated that 3 to 10 years (depending upon pre-heat temperature) would be required to recover the capital cost of the system in combustion air preheat applications. At this stage in the development of the recuperator, many factors in the analysis had to be assumed. Significant changes in some of the assumptions could dramatically affect the economics. For example, utilizing $2.85 per mcf for the natural gas price (as opposed to $2.00 per mcf) could reduce the payback period by more than half in certain cases. In addition, future commercial application will depend upon ceramic component manufacturing technique advances and cost reduction.

9301 (DOE/CS/40015—T1) Proposed industrial recovered materials utilization targets for the metals and metal products industry. (Little (Arthur D.), Inc., Cambridge, MA (USA)). May 1979. Contract AC03-78CS40015. 255p. NTIS, PC A12/MF A01.

Set targets for increased utilization of energy-saving recovered materials in the metals and metal products industries (ferrous, aluminium, copper, zinc, and lead) are discussed. Data preparation and methodology development and analysis of the technological and economic factors in order to prepare draft targets for the use of recovered materials are covered. Chapter 2 provides an introductory discussion of the factors that affect the recovery and reuse of secondary materials and the competition between the primary and secondary metals industries. Chapter 3 presents general profiles for the major industrial segments comprising SIC 33, including industry structure, process technology, materials and recycling flow, and future trends for the 5 industries: ferrous, aluminium, copper, zinc, and lead. Chapter 4 presents the evaluation of recycling targets for those industries. (MCW)

9302 (DOE/CS/40064—1) DOE wet pressing project. Progress report, October 1979-October 1980. Ceckler, W.H. (Maine Univ., Orono (USA)). 10 Nov 1980. Contract AS02-78CS40064. 17p. NTIS, PC A02/MF A01.

A computer model has been developed to predict water removed in the wet press section of a paper machine. When experimentally determined values for permeability and compressibility of the paper sheet are used the model predicts press behavior that agrees quite well with laboratory dewatering tests on the same type of paper. The results of permeability tests on a variety of papers are presented along with the effect of changes in fiber concentration for each of these materials. The design and performance of a laboratory compression tester is discussed along with results of compression tests on saturated and unsaturated samples of paper. Plans for both the pilot plant tests and mill trials which will be used to refine and test the final computer simulation model are discussed.

9303 (DOE/CS/40150—2) High consistency forming process for paper making. Part 1. A research, development, and demonstration program plan for the US Papermaking Industry. Final report. (Thermo Electron Corp., Waltham, MA (USA)). Apr 1980. Contract AC02-78CS40150. 161p. (TE—4250-216-80). NTIS, PC A08/MF A01.

The subject of research, development, and demonstration (RD and D) of energy conserving technologies applicable to papermaking operations downstream of the pulping process is addressed. An RD and D Program Plan is presented based on a survey of leading representatives of the papermaking industry, equipment manufacturers, consulting engineering firms, the American Paper Institute, and the Technical Association of the Pulp and Paper Industry. For perspective, the program plan is presented against the general background of the industry's current issues and concerns. The second part of the paper, Phase I, final report, deals with papermaking test facilities. The case for a centralized test facility is discussed. The results of a survey of existing pilot paper machines are presented. The energy saving potential of high consistency forming is considered and related to existing evidence. Simple theoretical models for the press nip action and the drying process are developed to predict where high consistency forming will reduce energy consumption. A special dynamic former has been designed, fabricated, and commissioned to allow development of a laboratory high consistency headbox. The design and construction of a low speed headbox has been completed and the complete system operated. Special equipment and techniques for the measurement of the

water and air permeability of sheet samples have been developed and are described.

9304 (DOE/CS/40339—T1) Insulation performance data and assessment procedures for steam kiln energy conservation investments. Zaccor, J.V. (Scientific Service, Inc., Redwood City, CA (USA)). Sep 1980. Contract AC03-80CS40339. 181p. NTIS, PC A09/MF A01.

For a demonstration project, the costs and benefits of insulating concrete block curing kilns to isolate the kiln thermal mass from the curing cycle are determined. Data were developed on service life of FOAMGLAS insulation, the effect of Johnson burners on the insulation and mounting, performance of an alternative insulation (a rapidly installed, spray-on polyurethane foam), and a simple incentive to promote implementation of industrial energy conservation concepts. Data are tabulated and compared for the FOAMGLAS and CPR 480 polyurethane insulations. Specific studies of insulation that was installed on inside surfaces of kilns to lock the kiln-mass out of the curing cycle are given for Blocklite plant in California, the Ameron pipe plant in California, and the Superlite plant in Phoenix, Arizona. (MCW)

9305 (DOE/R5/10107—T1) Surface-heating greenhouses with waste heated water. Final report. Walker, P.N.; Rand, H.J. (Illinois Univ., Urbana (USA). Dept. of Agricultural Engineering; Illinois Power Co., Decatur (USA)). Dec 1980. Contract FG02-79R510107. 11p. NTIS, PC A02/MF A01.

An aluminum framed glass greenhouse was constructed at the Baldwin Power Plant near St. Louis. The outside surface of this greenhouse was heated by flowing power plant cooling water over it. The water was applied at the ridge and allowed to run over the roof and sidewalls and into gutters where it was returned to the power plant's discharge canal. One season's heating performance data and resulting conclusions are presented. These results show that surface heating reduced conventional heat requirements by one third on the test greenhouse. However, when these results are projected to a commercial greenhouse the heating energy costs can be reduced by 67%. These cost savings would be 28% if 5°C cooler water were used and 90% if 5°C warmer water were used.

9306 (ORNL/MIT—315) Recovery of ORGDP waste heat as an energy source for converting biomass to fuels. Hunter, C.A.; Sciamanna, S.F.; Tormo, J.V. Jr. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 69p. NTIS, PC A04/MF A01.

Three ethanol-water distillation schemes capable of utilizing the ORGDP waste heat were investigated: (1) vacuum distillation at 12.67 kPa (95 mm Hg), (2) atmospheric distillation utilizing a heat pump to upgrade the waste heat, and (3) vacuum distillation at 6.67 kPa (50 mm Hg) using a refrigeration system to operate the overhead condenser. Distillation at 12.67 kPa to 95 wt % ethanol appeared to be the only alternative which might economically fit into an overall process for ethanol production using biomass conversion. Distillation at lower or higher pressures to 95 wt % ethanol was impractical because the heat pump and refrigeration units were extremely costly. Vacuum distillation to 99 wt % ethanol was not economically attractive because of the large number of trays required.

9307 (SERI/TR—733-790(Vol.2)) Current and future industrial energy service characterizations. Volume II. Energy data on the US manufacturing subsector. Krawiec, F.; Thomas, T.; Jackson, F.; Limaye, D.R.; Isser, S.; Karnofsky, K.; Davis, T.D. (Solar Energy Research Inst., Golden, CO (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA)). Oct 1980. Contract AC02-77CH00178. 271p. NTIS, PC A12/MF A01.

In order to characterize industrial energy service, current energy demand, its end uses, and cost of typical energy applications and resultant services in the industrial sector were examined and a projection of state industrial energy demands and prices to 1990 was developed. Volume II presents in Section 2 data on the US manufacturing subsector energy demand, intensity, growth rates, and cost for 1971, 1974, and 1976. These energy data are disaggregated not only by fuel type but also by user classifications, including the 2-digit SIC industry groups, 3-digit subgroups, and 4-digit SIC individual industries. These data characterize typical energy applications and the resultant services in this subsector. The quantities of fuel and electric energy purchased by the US manufacturing subsector were converted to British thermal units and reported in billions of Btu. The conversion factors are presented in Table 4-1 of Volume I. To facilitate the descriptive analysis, all energy cost and intensity data were expressed in constant 1976 dollars. The specific US industrial energy service characteristics developed and used in the descriptive analysis are presented in Volume I. Section 3 presents the computer program used to produce the tabulated data.

9308 (SERI/TR—733-790(Vol.3)) Current and future industrial energy service characterizations. Volume III. Energy data on 15 selected states' manufacturing subsector. Krawiec, F.; Thomas, T.; Jackson, F.; Limaye, D.R.; Isser, S.; Karnofsky, K.; Davis, T.D. (Solar Energy Research Inst., Golden, CO (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA)). Oct 1980. Contract AC02-77CH00178. 962p. NTIS, PC A99/MF A01.

An examination is made of the current and future energy demands, end uses, and cost to characterize typical applications and resulting services in the US and industrial sectors of 15 selected states. Volume III presents tables containing data on selected states' manufacturing subsector energy consumption, functional uses, and cost in 1974 and 1976. Alabama, California, Illinois, Indiana, Louisiana, Michigan, Missouri, New Jersey, New York, Ohio, Oregon, Pensylvania, Texas, West Virginia, and Wisconsin were chosen as having the greatest potential for replacing conventional fuel with solar energy. Basic data on the quantities, cost, and types of fuel and electric energy purchased by industry for heat and power were obtained from the 1974 and 1976 Annual Survey of Manufacturers. The specific industrial energy service characteristics developed for each selected state include: 1974 and 1976 manufacturing subsector fuels and electricity consumption by 2-, 3-, and 4-digit SIC and primary fuel (quantity and relative share); 1974 and 1976 manufacturing subsector fuel consumption by 2-, 3-, and 4-digit SIC and primary fuel (quantity and relative share); 1974 and 1976 manufacturing subsector average cost of purchased fuels and electricity per million Btu by 2-, 3-, and 4-digit SIC and primary fuel (in 1976 dollars); 1974 and 1976 manufacturing subsector fuels and electric energy intensity by 2-, 3-, and 4-digit SIC and primary fuel (in 1976 dollars); manufacturing subsector average annual growth rates of (1) fuels and electricity consumption, (2) fuels and electric energy intensity, and (3) average cost of purchased fuels and electricity (1974 to 1976). Data are compiled on purchased fuels, distillate fuel oil, residual fuel oil, coal, coke and breeze, and natural gas. (MCW)

9309 Generalized model for fuel choices with application to the paper industry. Chern, W.S. (Oak Ridge National Lab., TN); Just, R.E. Contract W-7405-ENG-26. *Energy Systems and Policy (U.S.);* **4**: No. 4, 273-294(1980).

This paper presents a generalized fuel-choice model in which restrictive constraints on cross-price coefficients need not be imposed, but all demand elasticities are uniquely determined. The model is applied to estimating aggregate energy demand and fuel choices for the pulp and paper industry. The structural equations are estimated by a generalized least-squares procedure using state-level census data for 1971 and 1974. The econometric results support the argument that third-price coefficients should not be constrained in estimating relative market-share equations. 14 references, 5 tables.

9310 Heat-pulsed recuperations. ASME Paper 79-WA/HT-39. Kardas, A. New York, NY; American Society of Mechanical Engineers (1979). 4p. (CONF-791205—24).

From ASME winter annual meeting; New York, NY, USA (2 Dec 1979).

A method of pressurizing hot products of combustion in order to move them through a heat-recovery system avoids conventional pumping by using the concept of heat-pulsed recuperation. It entails compressing the hot flue gas by a brief pulse burn, ejecting a fraction of the gas past the heat-transfer surfaces, lowering the chamber pressure below that found in the furnace by using the combustion air as a heat sink, and re-inducting fresh hot products of combustion from the furnace. A numerical example illustrates the concept.

9311 **(DOE/CS/40161—1) Alternatives to natural gas in metal coil coating. First topical report for the period September 27, 1978 - December 31, 1979.** Huebner, S.R. (Midland-Ross Corp., Toledo, OH (USA). Technical Center - Thermal Systems). [nd]. Contract AC01-78CS40161. 115p. NTIS, PC A06/MF A01.

The design, construction, and demonstration of an inert air metal coating line that does not use natural gas as the primary fuel for the process is developed. The concept utilizes an incinerator that uses electrically heated air to cleanly burn all evaporated solvents from the coil coating line to generate the process heat as well as provide an inert atmosphere for safe operation of the oven. The program envisaged the demonstration of these energy conservation concepts in an operational coil coating line at a host site. During the reporting period, a thermal review of coil coating technology was completed. From an efficient energy usage view point, system components that need be pursued were identified. Lacking a host for the operational coil coating line to incorporate the propsed system, the program has been revised for a laboratory demonstration of the concept. The design and construction of this unit will be carried out in subsequent phases of the program.

3206 Municipalities And Community Systems

9312 **(ANL/CNSV-TM—47) Case study of total energy system, Sher-Den Mall, Sherman, Texas.** Myrtetus, G.B.; Levey, M.D. (Total Energy Leasing Corp., New York (USA)). Dec 1980. Contract W-31-109-ENG-38. 189p. NTIS, PC A09/MF A01.

The Sher-Den Mall shopping center receives all of its electricity and heating and cooling energy from a total energy plant located within the shopping center proper. Four engine-generator units are fueled primarily by natural gas, with some fuel oil use. The following are presented: initial corporate planning, investigation, and feasibility studies; a description of the total energy system; capital costs; plant operations, and revenue structure. Tables, figures, exhibits, and equipment specification lists are presented. (MHR)

9313 **(ANL/EES-TM—96(Vol.2)) Energy optimization of water and wastewater management for municipal and industrial applications conference.** (Argonne National Lab., IL (USA)). Aug 1980. Contract W-31-109-ENG-38. 576p. (CONF-791237—(Vol.2)). NTIS, PC A25/MF A01.

From 12. IECEC conference on energy conservation in the treatment of industrial wastewaters; New Orleans, LA, USA (10 Dec 1979).

These proceedings document the presentations given at the Energy Optimization of Water and Wastewater Management for Municipal and Industrial Applications Conference, sponsored by the Department of Energy (DOE). The conference was organized and coordinated by Argonne National Laboratory. The conference focused on energy use and conservation in water and wastewater. The General Session also reflects DOE's commitment to the support and development of waste and wastewater systems that are environmentally acceptable. The conference proceedings are divided into two volumes. Volume 1 contains the General Session and Sessions 1 to 5. Volume 2 covers Sessions 6 to 12. Separate abstracts are prepared for each item within the scope of the Energy Data Base.

9314 (ANL/EES-TM—96(Vol.2), pp 91-100) **Extensive power savings through maximization of Saginaw-Midland Water Supply System pumping efficiency: a case study.** Howard, W.S. (Camp Dresser and McKee Inc., Boston, MA). Aug 1980.

From 12. IECEC conference on energy conservation in the treatment of industrial wastewaters; New Orleans, LA, USA (10 Dec 1979).

The Saginaw-Midland Water Supply System includes 3 pumping stations which supply two major municipal treatment facilities for a total design capacity of about 80 mgd. Two general routes were taken at the Saginaw-Midland system to develop efficient operating procedures: SMWSS in-house analysis (comparison of operating records with equipment specifications and actual operation under varied demand situations) and consultant analysis by engineers experienced in systems analysis, hydraulics, pumps, and motors. To evaluate potential power savings, it is recommended that the water utility manager should determine how much storage can be used safely, the operating characteristics of each pump, and the required discharge pressure at particular demand conditions. (MCW)

9315 (ANL/EES-TM—96(Vol.2), pp 117-127) **Optimization of water demand from three plants.** Barnes, S.E. (City of Columbus, Div. of Water, OH); Dumas, R.L. Aug 1980.

From 12. IECEC conference on energy conservation in the treatment of industrial wastewaters; New Orleans, LA, USA (10 Dec 1979).

The creation of an engineering tool that could potentially be used in many different studies resulted from a study to determine optimal load allocations for the water treatment plants of the City of Columbus, Ohio. The design of the water distribution system is described. A model was developed that represents the system. After the model was developed and before an optimization procedure could be established a cost model was formulated. Since the booster stations are operated independently of the rest of the system, booster station costs were not included. No construction costs are considered for the study so the only costs are those that vary directly with flows from the water plants. These include the chemical treatment costs and the electrical costs to pump the water. Difficulties with the computer model are identified. (MCW)

9316 (ANL/EES-TM—96(Vol.2), pp 173-182) **Energy savings by fluid bed regeneration of granular activated carbon.** Johnson, H.R.; Massey, M.L. (Westvaco Corp., Covington, VA). Aug 1980.

From 12. IECEC conference on energy conservation in the treatment of industrial wastewaters; New Orleans, LA, USA (10 Dec 1979).

Granular activated carbon (GAC) treatment has been used in both industrial and municipal wastewater treatment as well as in potable water treatment for control of objectionable tastes and odors. Thus, present designs of GAC treatment facilities incorporate the knowledge gained through years of full-scale operational experience. This experience has demonstrated that thermal regeneration is a cost-effective means of restoring the adsorptive capacity of spent activated carbon with the concomitant destruction of adsorbed organic material. This process has normally been carried out in multiple-hearth furnaces or rotary kilns. However, Westvaco Corporation has developed a fluidized bed furnace that offers significant advantages over traditional technology for the thermal regeneration of GAC. One of the most important advantages is the greatly reduced fuel requirements of the Westvaco Fluid Bed Regeneration System. The design and operational characteristics that provide this advantage will be discussed in this paper.

9317 (ANL/EES-TM—96(Vol.2), pp 269-278) **Energy use and recovery survey of wastewater treatment plants.** Taylor, R.J. (Johns Hopkins Univ. Applied Physics Lab., Laurel, MD). Aug 1980.

From 12. IECEC conference on energy conservation in the treatment of industrial wastewaters; New Orleans, LA, USA (10 Dec 1979).

An energy use and potential energy recovery survey of 13 wastewater treatment plants was accomplished in preparation for a national survey. The energy recovery information was sought for digester gas generation, grease and oils collected, hydroelectric potential, and thermal energy extraction from the effluent using heat pumps. A model was developed for initially estimating the potential hydroelectric power output, annual energy output, and costs of hydroelectric development at wastewater treatment plants. Four computer programs briefly described were written to assist in the analysis. Analyses of energy use and energy recovery are presented, but the results present no reliable conclusions.

9318 (ANL/EES-TM—96(Vol.2), pp 333-342) **Multivariate analysis of energy consumption for water pumping stations.** Repetto, D.W. (City of Chicago, IL). Aug 1980.

From 12. IECEC conference on energy conservation in the treatment of industrial wastewaters; New Orleans, LA, USA (10 Dec 1979).

A predictive model for monthly energy requirements for pumping water for a water system for the City of Chicago is presented. Historical data were used to develop the model. The study is directed at those systems where multiple pumping stations are used. The proposed method for analysis is multiple linear regression.

9319 (ANL/EES-TM—96(Vol.2), pp 483-494) **Private-public cooperation for effective energy conservation.** Faisst, W.K.; Smith, J.G. (Brown and Caldwell, Atlanta, GA). Aug 1980.

From 12. IECEC conference on energy conservation in the treatment of industrial wastewaters; New Orleans, LA, USA (10 Dec 1979).

Some general approaches to energy conservation that apply to water and waste water management are discussed. Several case histories are presented showing how such approaches may be implemented. Areas where additional improvement is possible but changes in methods or attitudes are needed for project success are pointed out.

9320 (DOE/EV—0115) **Air pollution control technology for municipal solid waste-to-energy conversion facilities: capabilities and research needs.** Lynch, J.F.; Young, J.C. (Department of Energy, Washington, DC (USA)). Sep 1980. 53p. NTIS, PC A04/MF A01.

Three major categories of waste-to-energy conversion processes in full-scale operation or advanced demonstration stages in the US are co-combustion, mass incineration, and pyrolysis. These methods are described and some information on US conversion facilities is tabulated. Conclusions and recommendations dealing with the operation, performance, and research needs for these facilities are given. Section II identifies research needs concerning air pollution aspects of the waste-to-energy processes and reviews significant operating and research findings for the co-combustion, mass incinceration, and pyrolysis waste-to-energy systems.

9321 **Conceptual design of transfer station materials and energy recovery facility, City of Berkeley, Solid Waste Management Center. Final report: executive summary.** San Francisco, CA; Brown, Vence and Associates (1980). 8p. City of Berkeley, Dept. of Public Works, Berkeley, CA.

A conceptual design was developed for the Berkeley Solid Waste Management Center incorporating modular combustion units. Markets for recovered materials and energy were confirmed in the study. Additional work briefly discussed covered an analysis of the waste stream; assessment of the front-end processing technology; an identification of regulatory agency requirements and environmental constraints; preparation of preliminary design and budget cost estimates for the transfer station/modular combustion plant; development of financing and procurement arrangements; identification of project risks; and establishment of an implementation master plan.

3209 Education And Public Relations

9322 (DOE/CA/11125—T1) **Sounds energetic: the radio producer's energy minibook.** (Granzow Communications, Washington, DC (USA)). Dec 1980. Contract FG03-80IR11125. 57p. NTIS, PC A04/MF A01.

The Minibook will be expanded into the final Radio Producer's Energy Sourcebook. Radio producers and broadcasters are asked to contribute ideas for presenting energy knowledge to the public and to be included in the Sourcebook. Chapter One presents a case study suggesting programming and promotion ideas and sample scripts for a radio campaign that revolves around no-cost or low-cost steps listeners can take to increase their home energy efficiency and save money. A variety of other energy topics and suggestions on ways to approach them are addressed in Chapter Two. Chapter Three contains energy directories for Baltimore, Philadelphia, Pittsburg, and Washington, DC. The directories will be expanded in the Sourcebook and will consist of a selection of local public and private sector energy-related organizations and list local experts and organizations and the best Federal, state, and local government programs that can provide consumers and citizens groups with information, technical assistance, and financial support. (MCW)

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

REFER ALSO TO CITATION(S) 9201, 9202, 9203, 9204, 9205

9323 (CONF-800419—(Vol.1), pp 9-10) **International status reports on automotive power system research and development: Canada.** Maund, G. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The status of automotive power system research and development in Canada is reported. Information is included on: automobile and truck fuel economy research; alternative fuels programs; and electric vehicle studies. (LCL)

9324 (CONF-800419—(Vol.1), pp 10-12) **International status reports on automotive power system research and development: France.** Roumegoux, J.P. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The status of automotive power system research and development in France is reported. Information is included on: engine fuel consumption improvements by changes in engine design, operation, control systems and by improved vehicle design for decreased drag. (LCL)

9325 (CONF-800419—(Vol.1), pp 12-14) **International status reports on automotive power system research and development: Federal Republic of Germany (FRG).** Praxenthaler, H. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The status of automotive power system research and development in West Germany is reported. Information is included on engine research for improved fuel economy and emissions control; alternative fuels, especially alcohol fuels; and overall vehicle performance, economy, and safety. (LCL)

9326 (CONF-800419—(Vol.1), pp 14-17) **International status reports on automotive power system research and development: Italy.** Lenti, F. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The status of automotive power system research and development in Italy is reported. Information is included on: automotive fuel consumption and economy; mobility requirements in Italian cities; flywheel propulsion systems; heat recovery in motor vehicles; engine research; hybrid electric buses; and the general goals of the research programs. (LCL)

9327 (CONF-800419—(Vol.1), pp 18) **International status reports on automotive power system research and development: The Netherlands.** Kuiperbak, J.G. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The status of automotive power system research and development in the Netherlands is reported. Information is included on automotive fuel consumption; alternative fuels; emissions control; and engine improvements. (LCL)

9328 (CONF-800419—(Vol.1), pp 19-21) **International status reports on automotive power system research and development: New Zealand.** Titchener, A.L. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The status of automotive power system research and development in New Zealand is reported. Information is included on automobile ownership; fuel consumption; and alternative automotive fuels; and research on fuels from indigenous materials such as coal and biomass. New Zealand engages in no basic research in these fields but is assessing domestic synthetic fuel production possibilities using methods developed abroad. (LCL)

9329 (CONF-800419—(Vol.1), pp 21-23) **International status reports on automotive power system research and development: Spain.** Hernando, J. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The status of automotive power system research and development in Spain is reported. Studies in progress include the use of LPG, development of electric vehicles, use of gasohol, methane derivation from biomass and the supercharging of engines. (LCL)

9330 (CONF-800419—(Vol.1), pp 23-30) **International status reports on automotive power system research and development: Sweden.** Ulvonas, S. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The status of automotive power system research and development in Sweden is reported. Information is included on programs involving: alternative fuels, mainly methanol; reduced vehicle drag; improved engines and electric-drive systems; energy storage systems for vehicles; and fuel cells. (LCL)

9331 (CONF-800419—(Vol.1), pp 30-31) **International status reports on automotive power system research and development: Switzerland.** Berchtold, M. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The status of automotive power system research and development in Switzerland is reported. These efforts are directed at improving the fuel economy of diesel engines for cars and trucks and include the development of superchargers and synthetic diesel fuels and studies of combustion processes and emissions controls. (LCL)

9332 (CONF-800419—(Vol.1), pp 31) **International status reports on automotive power system research and development: United Kingdom.** Minto. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The status of automotive power system research and development in the United Kingdom is briefly reviewed. (RCK)

9333 (CONF-800419—(Vol.1), pp 32-33) **International status reports on automotive power system research and development: United States.** Thur, G.M. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The status of automotive power system research and development in the US is reported. Information is included on: programs for developing gas turbine engines, the Stirling engine, alternative fuels, and improved vehicle design. (LCL)

9334 (CONF-800419—(Vol.1), pp 37-40) **Role of technology for tomorrow's transportation: investment and finance.** Keller, M.N. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Energy-related disruptions in the automobile marketplace since 1979 have had a profound effect on profitability, product plans, dividends, and strength of the US automobile industry. Insufficient small car and truck capacity has contributed to unprecedented expansion of the import share of both vehicle markets. The domestic automobile industry's response to this changing market is discussed. (RCK)

9335 (CONF-800419—(Vol.1), pp 41-42) **Role of technology for tomorrow's transportation: automotive industry.** Withrow, J.D. Jr. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The industry viewpoint on the subject of energy and the automobile is discussed in the following context: historical role of technology in the automobile industry, the present status of the industry, the challenges of tomorrow, and what to expect from technology in the future. Some of the steps being taken by the industry to meet the challenges of the future are presented. (RCK)

9336 (CONF-800419—(Vol.1), pp 96-102) **Market trends, projections, and applications: projections of light-duty fuel demand: the Sweeney and Green Model.** Emerson, F. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The development of a model for forecasting automobile fuel demand in the US for the period from 1985 to 1995 is discussed. This model attempts to take into account the effects of the following factors on this fuel demand: on-the-road fleet fuel efficiency, population, income, fuel prices, vehicle prices, and make-up of the stock of vehicles. (LCL)

9337 **(CONF-800419—(Vol.1)) APS-5.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy). Oct 1980. 602p. NTIS, PC A99/MF A01.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Fifty-three papers or panel discussions were presented at the meeting. A separate abstract was prepared for each of 50 papers. Three papers were previously processed for the Energy Data Base. Abstracts for individual papers were not prepared for Energy Abstracts for Policy Analysis (EAPA). (LCL)

9338 **(CONF-800419—(Vol.2)) APS-5.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy). Oct 1980. 573p. NTIS, PC A24/MF A01.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Thirty papers presented at the meeting are included in this volume. A separate abstract was prepared for each of 28 papers. Two papers were previously processed for the Energy Data Base. Abstracts for individual papers were not prepared for Energy Abstracts for Policy Analysis (EAPA). (LCL)

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 8848, 9383, 9384, 9385, 9386, 9393, 9394, 9395, 9396, 9397, 9397

9339 (CONF-800419—(Vol.1), pp 74-81) **Market trends, projections, and applications: environmental assessment of US Department of Energy Office of Transportation Programs (OTP).** Mihlmester, P.E.; Dulla, R.G. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The environmental assessment (EA) process as applied to transportation technology developments is described and then applied to the Turbocompound Diesel Engine (TDE) Program and the Controlled Speed Accessory Drive (CSAD) Program. Based on the discussions presented in the EA's for the CSAD and TDE programs, a recommendation to prepare a finding of no significant impact was made in both cases. This recommendation was given because it was assumed that the adverse engine cooling problem associated with the installation of CSAD systems would be remedied by overall engine-CSAD optimization. In addition, the small expected impact from the current TDE program and the lack of quantitative health and safety data necessary to reach a conclusion about the environmental impacts of TDE systems were factors in making the decision. However, it is expected that the TDE EA will be updated as the program develops and that the need for a programmatic EIS will be evaluated as updates are prepared. (LCL)

9340 (CONF-800419—(Vol.1), pp 133-145) **Market trends, projections, and applications: gas turbine commercialization.** Thur, G.M. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Past developments of gas turbines for powering road vehicles and the advantages of the gas turbine as compared with spark ignition or diesel engines, i.e., higher fuel efficiency ability to use alternative fuels, and lower air and noise pollution, are reviewed. However, to become commercially feasible, demonstration pro-

grams for gas turbines used in alcohol-fueled buses, petroleum-fueled buses, military vehicles, heavy trucks and luxury cars are needed, and funding initiatives by Congress to promote the commercialization of gas turbines are recommended. (LCL)

9341 (CONF-800419—(Vol.1), pp 147-157) **Automotive gas turbine systems: AGT101 advanced gas turbine powertrain system development project.** Rackley, R. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The goal of this project is to develop and demonstrate by May 31, 1985, an advanced automotive gas turbine powertrain that meets the following objectives: 36 mpg gasoline, 41 mpg diesel (M-H) in a 1985 Ford automobile (3125 pounds inertia weight); substantially same overall driveability and performance as conventional spark ignition vehicle; emissions of NOx = 0.4 g/mile, HC = 0.41 g/mile, CO = 3.4 g/mile, and total particulate level 0.2 g/mile; ability to use variety of fuels (five maximum); reliability and life comparable to current market powertrains; competitive initial cost and life-cycle cost; acceleration suitable for safety and consumer consideration; and noise and safety characteristics meeting Federal standards of 1984. This project was initiated October 1, 1979, and is proceeding on schedule. The initial milestone, the Preliminary Design Review (PDR) of the Reference Powertrain Design (RPD) was successfully completed January 30, 1980. The RPD represents a design that could be produced after 1985. The reference powertrain design consists of a Ford 4-speed automatic overdrive transmission unit now in production, a gear box for matching the single-shaft engine power to the 4-speed transmission, and the gas turbine power unit. The predicted performance of this reference powertrain in the 1985 Ford vehicle meets all project objectives, and awaits experimental verification. (LCL)

9342 (CONF-800419—(Vol.1), pp 158-180) **Automotive gas turbine systems: advanced gas turbine powertrain system development project.** Helms, H.E. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The goals and objectives for this 68-month Advanced Gas Turbine Powertrain System Development Project are: to demonstrate fuel economy of 42.5 miles per gallon in a 1985 Pontiac Phoenix, multi-fuel capability, and emission levels within the Federal Standards; and to design for competitive reliability and life, competitive initial and life-cycle costs, safe vehicle acceleration and maneuverability, and vehicle noise and safety characteristics within the Federal Standards. High risk and key elements in this advanced powertrain project are the development of ceramic turbine engine components and the aerodynamic development of small size turbine components. Begun in Oct 1979, the initial activity was extensive component development including turbine parts design, ceramic materials processing, and compressor combustor and regenerator development, and control system design. Performance analyses of the 1985 Phoenix with this power train shows good acceleration and maneuverability characteristics on an estimated average fuel economy of 42.5 mpg. (LCL)

9343 (CONF-800419—(Vol.1), pp 181-203) **Automotive gas turbine systems: status of the Volkswagen automotive gas turbine program.** Walzer, P. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The development at Volkswagen AG of automotive gas turbines and an experimental gas turbine car is discussed. The experimental gas turbine is a two-shaft type engine with regenerative air-preheating and integrated reduction gear. The gasifier and power turbine operate in the longitudinal axis of the power plant. The gasifier turbine powers the compressor and the auxiliaries required for the operation of the power plant and of the vehicle. The power turbine powers the output shaft through a reduction gear. The heat exchanger consists of two laterally arranged regenerator discs. The engine is equipped with variable inlet guide vanes for the compressor and variable nozzles for the power turbine and is controlled by an electronic-hydraulic device. The test vehicle is an RO 80, an Audi NSU production model retrofitted for rear wheel drive, automatic 3-speed transmission, a brake booster, and power-assisted steering. The total vehicle test weight with engine was 1700 kg. The vehicle had a composite fuel economy of 18.7 mpg operating on diesel fuel, gasoline, kerosene, or methanol measured in the US City and Highway Cycle. Further improvements, particularly in fuel consumption during idling are sought. Materials development for ceramic-bladed and all-ceramic rotors is being investigated. (LCL)

9344 (CONF-800419—(Vol.1), pp 204-213) **Automotive gas turbine systems: development and application of ceramic components for automobile gas turbines.** Yamazaki, S. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Experimental research on how ceramic materials can be utilized in automobile gas turbine components, together with studies on the feasibility of a passenger car ceramic gas turbine, are discussed. The performance of a high-efficiency ceramic gas turbine for a passenger car is discussed and the results of a proof test on ceramic combustors and ceramic rotational parts that were obtained with a test rig are set forth.

9345 (CONF-800419—(Vol.1), pp 214-234) **Automotive gas turbine systems: status of the Ford program to evaluate ceramics for stator applications in automotive gas turbine engines.** Trela, W. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The objectives of this DOE/NASA Ford Program are to assess current ceramic materials, component fabrication processes, and reliability prediction capability for one-piece ceramic stators in an automotive gas turbine engine environment. Simulated engine duty cycle testing of stators is being conducted at temperatures up to 1204°C (2200°F). Materials being evaluated are SiC and Si_3N_4 fabricated from two near-net-shape processes: slip casting and injection molding. Participating vendors are supplying stators for durability cycle evaluation and test specimens for material property characterization. One-piece ceramic stators of a common design were fabricated by several suppliers. Overall progress of the four major technical tasks, reliability prediction, stator fabrication, material characterization, and stator evaluation, is reviewed. Results of stator evaluation include the qualification tests and duty cycle durability tests for Si_3N_4 and SiC stators during more than 1000 hr of cyclic testing.

9346 (CONF-800419—(Vol.1), pp 235-246) **Heavy-duty gas turbine upgrading and commercialization; ceramic applications in turbine engines.** Hudson, S.M. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The objective of this project is to reduce fuel consumption in a highway vehicle gas turbine engine by increased turbine temperature and, in turn, engine efficiency through the application of ceramic components. The approach being used to achieve this objective centers on a process of stepwise turbine temperature growth using the basic Allison GT-404 engine as the demonstration powerplant. The temperature growth is from a baseline GT-404 level of 1835°F through 1900°F and 2070°F to a maximum level of 2265°F. This engine demonstration effort is supported by a balanced program of material and process development, material characterization and analytical/tool development, and component demonstration and test. The development of turbine rotor blades of both sintered silicon carbide and silicon nitride materials and of aluminum silicate seals is discussed. (LCL)

9347 (CONF-800419—(Vol.1), pp 247-248) **Heavy-duty gas turbine upgrading and commercialization: intercity gas turbine bus demonstration program.** Pawlisz, R.M. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

A demonstration program seeking to develop intercity bus turbine engines capable of providing clean, efficient, reliable power is described. Four buses equipped with gas turbines have been delivered for intercity service. The turbine-powered bus met or exceeded 1983 EPA requirements and performance testing is in progress. (LCL)

9348 (CONF-800419—(Vol.1), pp 249-267) **Heavy-duty gas turbine upgrading and commercialization: Ingredients for the commercial acceptance of gas turbine power.** Penny, R.N. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The need for developing gas turbine-powered vehicles to achieve petroleum conservation is stressed, and the technical and economic progress in developing low-cost, efficient, marketable gas turbines is reviewed. (LCL)

9349 (CONF-800419—(Vol.1), pp 268-277) **Heavy-duty gas turbine upgrading and commercializationn: near-term GT-601 engine demonstration for trucks.** Litterman, F. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

A program for demonstrating the technical and economic feasibility of gas turbine engines for trucks is described. To date the economic feasibility has been established, basic mechanical integrity and vehicle driving characteristics have been demonstrated, and long-term mechanical durability remains to be proven. (LCL)

9350 (CONF-800419—(Vol.1), pp 278-284) **Heavy-duty gas turbine upgrading and commercialization: gas turbine transit bus demonstration program.** Ross, R. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The objective of the program is to accelerate acceptance and commercialization of gas turbine engine technology by conducting a comprehensive demonstration project that provides operational experience and data to the transportation industry. This program has been planned in three phases to demonstrate progressing engine improvements as transit coach gas turbine engines move toward commercialization. Each phase consists of bus/engine integration, proving grounds tests, and revenue service demonstration. In the current first phase, five prototype gas turbine engines, Model GT-404-4, are being integrated into five RTS-II Model transit coaches, supplied by the Mass Transit Administration (MTA) of Baltimore, Maryland. They will all be acceptance-tested at the Transportation Research Center Proving Grounds in Ohio, where one gas turbine coach will also be performance and mileage tested against a diesel RTS-II coach. Then the five turbine coaches will be demonstrated in revenue service on the streets of Baltimore for one year. They will operate out of the Bush Street Division, be driven by MTA drivers, and repaired and serviced by MTA mechanics. The first diesel-to-turbine engine conversion is done.

9351 (CONF-800419—(Vol.1), pp 427-443) **Materials technology: 3500-hour durability testing of ceramic materials for automotive gas turbine engines.** Carruthers, W.D. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

A test facility for evaluating the influence of long-term cyclic thermal exposures simulating gas turbine engine conditions was developed and used to test four commercially available ceramic material candidates for automotive gas turbine use. These 4 materials included hot-pressed and reaction-bonded silicon nitrides and sinter and siliconized silicon carbides. The design and operation of the test facility are discussed. Thermal exposures at 1200 and 1370°C (2200 and 2500°F) for periods up to 3500 h were selected to simulate the environment encountered by hot flow path components in an automotive application. The cyclic thermal exposure program was constructed so that materials would be selectively exposed to successively longer cyclic thermal environments. Thus, all materials were initially exposed for 350 h/1750 cycles at 1200°C and 1370°C. Successive testing to 1050, 2100, and 3500 h was performed on those materials which maintained at least 50% of baseline strength after each exposure as measured by room temperature four-point flexure. Materials selected for the 3500 h cyclic exposure were also subjected to 350- and 1050-h isothermal exposures. The test results for degradation and for temperature cycling effects on each material are discussed. Sintered α-SiC appears to be a prime material for automotive gas turbine development. (LCL)

9352 (CONF-800419—(Vol.1), pp 444-454) **Materials technology: ceramic parts for a diesel engine.** Hamano, Y. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The feasibility of using ceramics as diesel engine parts and the design and fabrication of ceramic engine parts were studied. Sintered silicon nitride, SN-220, was selected for testing. The parts fabrication methods included iso-pressing, green machining, firing, and finish grinding to dimensional tolerances. Durability, flexural strength, thermal conductivity, and elastic deformation were measured at temperatures up to 1400°C. A small diesel engine using sintered silicon carbide parts was fabricated and ran successfully for about 300 h at full load. (LCL)

9353 (CONF-800419—(Vol.1), pp 470-481) **Materials technology: sintered silicon nitride.** Katz, R.N.; Greskovich, C.D. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The fundamental problems which must be overcome to attain near full density sintered silicon nitride and the processing and microstructural development required to generate properties appropriate to small automobile gas turbine rotors are reviewed. (LCL)

9354 (CONF-800419—(Vol.1), pp 482-499) **Materials technology: review of GTE sintered Si_3N_4 structural ceramics.** Quackenbush, C.L. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

GTE has pioneered the development of a sinterable Si_3N_4 powder and currently markets sintered Si_3N_4 structural parts. The powder and its role in achieving sintered Si_3N_4 based parts and the oxidation properties and mechanical strength of these compositions are discussed.

9355 (CONF-800419—(Vol.1), pp 500-513) **Materials technology: development of moldable, high density reaction-bonded silicon nitride.** Mangels, J.A. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

A program was initiated in 1978 (supported by DOE and NASA) to develop an improved grade of injection moldable, reaction-bonded Si_3N_4. The program had the principal objectives of: developing a material with a density of at least 2.8 g/cc; developing a material with a strength of at least 344 MPa with a minimum Weibull modulus of 10.0; and fabricating a complex shaped component to demonstrate that the technology developed can be reduced to engineering practice. During the course of this reaction-bonded Si_3N_4 development program, technological advancements were made in two distinct areas: injection-molding and nitriding. It was found that to injection-mold ceramic powders to high density levels, the particle size and the particle morphology are equally important. It is important to have a broad particle size distribution and an agglomerated particle morphology where the fine particles are attached to the coarse particles. These criteria can be obtained by dry ball milling. The importance of the effect of the nitriding atmosphere and, to a lesser degree, the nitriding time upon the nitriding behavior of dense silicon compacts was demonstrated. The balance between nitriding atmosphere and nitriding time resulted in the successful nitriding of dense (2.8 g/cc) compacts of reaction-bonded Si_3N_4. The program objectives were met or exceeded. An RBSN material was developed which had a density of 2.8 g/cc. The compacts were completely nitrided, having a room temperature strength of 361 MPa, a 22.3 % improvement from the start of the program and 5 % over the program objective of 344 MPa. The Weibull modulus was 11.1, 11 % over the program objective of 10.0. The oxidation resistance of this material was improved by 55 % over the 2.7 g/cc baseline value. Turbine stator vanes were injection-molded to near-net shape and successfully nitrided, showing this material has potential for engineering applications. (LCL)

9356 (CONF-800419—(Vol.1), pp 544-568) **Vehicle systems: vehicle testing of a turbocompound heavy-duty diesel engine.** Brands, M.C. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

A development program has been underway since 1972 to perfect a turbocompounded diesel engine. This engine is a hybrid diesel reciprocator which is augmented in power from a low pressure free power turbine. Turbine power generated by exhaust gas expansion is transferred back to the drive train by means of mechanically gearing the power turbine to the rear of the engine crankshaft at a fixed speed ratio. A fluid coupling serves the function of separating the harmful crankshaft torsionals from the high-speed gearing. The laboratory engineering development of the compound engine has reached a mature stage following the evolution of three power turbine and gear train designs to the point of having reached a preproduction prototype system. The next logical evaluation involved vehicle performance testing. The results of the vehicle tests conducted are described. Two turbocompound diesel engines were installed in Class VIII vehicles to determine the fuel conservation potential and general performance characteristics of this power plant. In comparison to the NTC-400 engine selected for baseline measurements, the turbocompound engine achieved a fuel consumption benefit of 14.87 %. Drive-by noise tests showed a 1 to 2 dBA lower sound intensity with the compound engine. Driveability testing revealed better throttle response characteristics in spite of the higher specific output rating. In gradeability tests equivalent performance could be achieved with the transmission in one higher gear ratio. Engine retardation was marginally superior with the turbocompound engine. (LCL)

9357 (CONF-800419—(Vol.2), pp 615-626) **Diesel engine advances: status of DOE diesel research program.** Brooks, A.L. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The principal objective of the DOE diesel program is to develop information that will enable DOE and other Government agencies to assess the environmental acceptability of light-duty diesel engines, particularly the potential health hazard. The research is directed toward an integrated risk assessment of light-duty diesels, including the relative risks of diesels versus other light-duty engines or other environmental health risks. It will also assess the technical features of diesels, the potential control measures that might be used for particulate reduction, and advanced diesel technologies. Activities within this program are discussed. (LCL)

9358 (CONF-800419—(Vol.2), pp 667-682) **Diesel engine advances: Isuzu new 4FB1 1.8L high-speed diesel engine.** Hikosaka, N.; Takeuchi, K. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The following features of the 4FB1 1.8 liter diesel engine developed in Japan for smaller fuel-efficient automobiles are described: fuel economy and weight reduction; engine noise and exhaust emissions; engine performance; and ease of operation. (LCL)

9359 (CONF-800419—(Vol.2), pp 683-700) **Diesel engine advances: development of a 225-cubic-inch diesel engine.** Scott, W.M. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The development of a diesel version of the Chrysler RG225 gasoline engine as fitted to the Chrysler Volare, Dodge Aspen, etc., cars, is described. Information is included on component design changes which accommodate a goal of minimizing the capital expenditure required for converting existing gasoline engine production facilities to diesel engine production. Laboratory and vehicle testing of engine performance is discussed. Test results demonstrated that a very acceptable passenger car diesel engine can be developed from a typical US gasoline engine with minimum sacrifice of acceptability criteria for the sake of fuel economy. In particular, it has been shown that specific performance similar to that expected from European light-duty diesels and equal to US gasoline engines can be achieved without durability limitations while retaining a high degree of commonality with the original gasoline engine. Gaseous emission levels close to the -.41, 3.4, 1.5 emission control requirement can be achieved from a 4000-pound vehicle without recourse to exhaust gas recirculation, making the eventual achievement of 1.0 g/mile NOx that much easier. In areas whre the diesel is still falling short in acceptability, such as in car heating, means exist for further improvement. (LCL)

9360 (CONF-800419—(Vol.2), pp 701-714) **Advanced spark ignition engines: on-board microprocessors and the evolution of the automobile.** Lenard, M.; Bluestein, J. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The adaptation of digital microprocessors to spark ignition engines for the purpose of controlling fuel-air ratios which in turn regulate engine emissions to within legally required limits and which affect engine fuel economy, spark timing, idler settings, and auxiliary loads and the impact of these control systems on fuel economy, emissions, safety, the automobile industry and the consumer are discussed. (LCL)

9361 (CONF-800419—(Vol.2), pp 715-725) **Advanced spark ignition engines: new two-cycle, spark-ignited engine.** Berchtold, M.; Eggart, C. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Two-cylinder spark-ignition engines are used extensively in boats and mobile gasoline-fueled power tools such as saws and lawn mowers but are inefficient and have high emissions. An in-progress project to improve the fuel economy and hydrocarbon emission characteristics of these small engines is described. Laboratory tests on engine performance with crankcase scavenging, direct fuel injection, supercharging, and varying fuel-air mixtures are reported. A maximum thermal efficiency of 33% was achieved with scavenging and direct fuel injection and hydrocarbon emissions were lower than for a conventional 2-cycle engine. (LCL)

9362 (CONF-800419—(Vol.2), pp 726-740) **Advanced spark ignition engines: update of the direct injected stratified charge rotary combustion engine developments at Curtiss-Wright.** Jones, C. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Over the past 21 years of rotary (Wankel-type) engine, active research testing at Curtiss-Wright, prototype carburetted automotive engines have been developed for application comparison to existing engines. By late 1976, Curtiss-Wright had developed engine rig data which demonstrated fuel consumption equal to or better than contemporary automotive diesel engines, clear potential to satisfy known emission requirements, and ability to burn a wide range of fuels without regard to octane or cetane rating. Information is presented on the stratified charge process and its application to rotary engines, and test procedures and results for stratified charge rotary engine models. These tests support the conclusion that engineering production model development, without a requirement for new breakthroughs, can be effected within a decade. (LCL)

9363 (CONF-800419—(Vol.2), pp 741-762) **Advanced spark ignition engines: TOP-thermodynamically optimized Porsche engine.** Gruden, D.O. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Current demands for improved fuel economy in automobiles have intensified the use of automotive diesel engines. The operation of diesel and Otto (spark-ignition) cycle engines and their theoretical efficiencies are discussed, and performance data are presented for standard diesel engines with 21.0 and 22.0 compression ratios and for the Thermodynamically Optimized Performance (TOP) engine, Otto cycle engine with its compression ratio boosted from about 8 up to 12.6. These test results showed that the TOP engine had better performance characteristics for acceleration and maximum speed, approximately the same fuel economy, and only slightly higher exhaust emissions (but well within European emission limits) as compared with the diesel engine. The lower compression ratio TOP engine has much improved knock characteristics. (LCL)

9364 (CONF-800419—(Vol.2), pp 763-779) **Advanced spark ignition engines: investigation of high compression ratio S.I. engine by a two-dimensional model.** Lee, W.; Schafer, H.J.; Schapertons, H. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Since the invention of the internal combustion (IC) engine, it has been a well-known fact that the most important physical process in the combustion chamber is the combustion itself. As major problems are raised by analyzing experimentally the extremely fast and complex combustion process in standard production engines, advanced numerical simulation techniques are required. Therefore, many mathematical models, including a 2-dimensional model, of the combustion have been developed in recent years. The main advantage of a multi-dimensional model is the fact that it takes into account the effects of combustion chamber geometry on the process of combustion. Therefore, the model has been applied to investigate into the effects on combustion, if different chamber designs are used. Because of the better thermal efficiency for high compression ratio engines, this study was performed for that type of engine. Results of test bench experiments are compared to the predicted trends. The two-dimensional mathematical model was able to give an insight into the physical processes of flame propagation and flow field evolution, which both affect fuel consumption; if the combustion is fast, the indicated thermal efficiency increases, but the gas velocities increase as well, so that heat losses to the walls become higher which, in turn, decreases efficiency. (LCL)

9365 (CONF-800419—(Vol.2), pp 791-801) **Engine fuel relationships: automobile engine fuel requirements.** Nichols, R.J.; Ronzi, R.C. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

This summary presents the specific fuel requirements of seven general engine types considered candidates for future transportation vehicles. They are: carburetted or central injection spark ignition; port-injected spark ignition; direct injected, stratified charge (Ford PROCO); fuel-optimized, stratified charge spark ignition; diesel (compression ignition); gas turbine; and Stirling. The combustion characteristics of the following alternative fuels are also presented along with major advantages and disadvantages: hydrogen; methane; propane; alcohols; gasoline from methanol; diesel fuel; oil shale hydrocarbons; and coal-derived hydrocarbons.

9366 (CONF-800419—(Vol.2), pp 837-846) **Engine fuel relationships: should we have a new knock rating.** Rossini, G. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Discussed are the need for and advantages of a new fuel octane rating or antiknock rating system, based on $(\Delta P)^2/\Delta T$ divided by E, in which ΔP = is the overpressure charge in the engine combustion chamber, Δt is the time interval during which Δ' occurs, and E = the modulus of elasticity of the mass of the burning gas.

9367 **(DOE/CS—0069/1) Second annual report to Congress on the Automotive Technology Development Program.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy). 30 Sep 1980. 30p. NTIS, PC A03/MF A01.

Progress in the Automotive Technology Development Program for the year ending September 30, 1980 is reported. This program is aimed at developing for commercialization advanced gas turbine (AGT) engines, advanced Stirling engines (ASE), and innovative, more efficient vehicles and vehicle components to use with advanced, energy-conserving automotive propulsion systems. For the AGT, the major accomplishments for this period included: awarded contracts for AGT development; completed reference powertrain design; initiated design and fabrication of testing facilities; and testing of components. For the ASE, design review is on schedule, and components have been tested up to 4000 h. A turbocompound diesel engine completed 54,000 miles of road testing and showed a 5% fuel economy improvement. Ten thousand miles of road testing a prototype Diesel Organic Rankine Bottoming Cycle in a heavy truck engine showed a 10% fuel economy gain. Three hundred standard GSA vehicles, operated with a Controlled Speed Accessory Drive showed, a 6 to 8% fuel economy gain. Four gas turbines have been installed in intercity buses, and five more are being installed in intracity buses in Baltimore. (LCL)

9368 **(DOE/NASA/4936—80/1) Vehicle testing of Cummins turbocompound diesel engine.** Brands, M.C.; Werner, J.R.; Hoehne, J.L. (Cummins Engine Co., Inc., Columbus, IN (USA)). Jun 1980. Contract AC02-78CS54936. 64p. (NASA-CR—159840; CTR—0746-80002). NTIS, PC A04/MF A01.

Two turbocompound diesel engines were assembled and dynamometer tested. Both engines met the 1980 California 6 gram emission limit on BSNO/sub X/+HC and achieved a minimum BSFC of .313 lb/bhp-hr and a BSFC at rated conditions of .323 lb/bhp-hr. These engines were then installed in Class VIII heavy-duty vehicles to determine the fuel consumption potential and performance characteristics. One turbocompound powered vehicle was evaluated at the Cummins Pilot Center where driveability, fuel consumption, torsional vibration, and noise were evaluated. Fuel consumption testing showed at 14.8% benefit for the turbocompound engine in comparison to a production NTC-400 used as a baseline. The turbocompound engine also achieved lower noise levels, improved driveability, improved gradeability, and marginally superior engine retardation. The second turbocompound engine was placed in commercial service and accumulated 50,000 miles on a cross-county route without malfunction. Tank mileage revealed a 15.92% improvement over a production NTCC-400 which was operating on the same route. A number of component modifications were incorporated in the turbocompound engine which resulted in fuel consumption reductions which exceeded the expected benefit from turbocompounding alone. Previous laboratory testing showed a 6% reduction in fuel consumption for a turbocompound engine over an equivalent NH engine operating along the torque curve. Using these test results, the incremental fuel consumption improvement strictly due to the turbocompounding alone was estimated at 4.2% to 5.3% for the interim turbocompound engine depending upon the terrain or mission load factor.

9369 **(LBL—11880) Enhanced ignition for I.C. engines with premixed charge.** Dale, J.D.; Oppenheim, A.K. (Alberta Univ., Edmonton (Canada); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 48p. (CONF-810206—3). NTIS, PC A03/MF A01.

From Society of Automotive Engineers international engineering congress and exposition; Detroit, MI, USA (23 Feb 1981).

The development of lean charge, fast burn engines depends crucially on enhanced ignition, since one can obtain thereby proper means for increasing the rate of burn in mixtures characterized notoriously by low normal burning speeds. Enhanced ignition involves a wide dispersion of its sources so that combustion is carried out at as many sites throughout the charge as possible. Upon this premise, various ignition systems for I.C. engines, operating with premixed charge, are reviewed. The systems are grouped within the following categories: (1) high energy spark plugs; (2) plasma jet igniters; (3) photochemical, laser, and microwave ignition concepts; (4) torch cells; (5) divided chamber stratified charge engines; (6) flame jet igniters; (7) combustion jet ignition concepts; (8) EGR ignition system. The first three derive the power from electrical energy, the rest are powered by exothermic chemical reactions at a significantly lower, practically negligible, fuel consumption. The concept of staging the processes of initiation and propagation of combustion is emphasized. Relative positions of various ignition systems are expressed on the plane of relative energies and relative volumes. In principle, ignition systems for engines operating with premixed charge lie on the half-plane of relative energies below one, between 10^{-5} for standard spark plugs to 10^{-1} for divided chamber stratified charge engines, while their relative volumes extend from 0 for spark igniters to 0.2 for stratified charge engines. This suggests that proper compartmentization of the combustion process may lead to significant improvements in both pollution emissions from the cylinder and specific fuel consumption of I.C. engines.

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9370 (CONF-800419—(Vol.1), pp 285-303) **Stirling Engine Systems: overview of a Stirling engine test project.** Slaby, J.G. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The NASA Lewis Research Center has overall project management responsibility for the DOE Stirling Engine Highway Vehicle Systems Program. In support of this engine development activity, the Lewis Research Center is conducting some in-house Stirling engine technology tests to develop alternative, back-up component concepts for better engine efficiency and performance or lower costs. Currently, there are three Stirling engines under test: RE-1000 - a 1.33 horsepower (1-kW) output free-piston single-cylinder Stirling engine; a ground power unit Stirling engine (GPU-3) with a single-cylinder rhombic drive; and a United Stirling 53-horsepower (40-kW), four-cylinder, double-acting engine - P-40. The design, operation, performance and component evaluation of each engine is described. The three Stirling engines under test are contributing to the development of a broader base of Stirling engine technology. Although the testing is in the early stages, several attractive alternative component concepts are being evaluated, and computer predictions are being used to screen other potential component candidates. The early engine test results confirm expectations that the Stirling engine is indeed a viable contender for automotive application. (LCL)

9371 (CONF-800419—(Vol.1), pp 304-322) **Stirling Engine Systems: automotive Stirling engine development program.** Nightingale, N.P. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The major objectives of the Automotive Stirling Engine Development Program are to develop an automotive Stirling engine which demonstrates 30% better fuel economy than a conventional spark-ignition engine installed in a comparable production vehicle and which meets the 1985 Federal Emissions Standards. Early in the program, the adaptability and capability of the Stirling engine were demonstrated. A P-40 engine (40 kW) manufactured and assembled by United Stirling of Sweden was installed and operated in a 1977 Opel 2100 diesel sedan. Another P-40 engine was installed by AM General in a 1979 Spirit. Mileage and emissions data on these vehicles compared favorably with the originally installed engines, even though the P-40 is not an automotive engine. Currently, the first generation automotive Stirling engine, called the Mod I, is being designed and will be tested early in 1981. Its projected mileage of 26.6 mpg in a 1981 Spirit represents a 22% improvement over the conventionally installed four-cylinder I.C. engine. A Reference Engine has also been designed within the program to reflect the second generation engine in the program, to be called the Mod II. It will be packaged in a front-wheel-drive vehicle and is required to meet the final program objectives quoted above. Progress in the project tasks such as reference engine design, component development, assembly, installation, and testing of the Mod I engine is reported. To date the P-40 engine total test time exceeds 3500 h, and component rig test time exceeds 6700 h. (LCL)

9372 (CONF-800419—(Vol.1), pp 323-335) **Stirling Engine Systems: ASE Mod 1 engine design.** Holgersson, S. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Progress in the development of the Mod I and Mod II engines for the Automotive Stirling Engine (ASE) Program is reviewed. The design work with the Automotive Stirling Engine Mod I is in the final stage. The Basic Stirling Engine has been frozen. Projected performance data show an improvement in mileage of approximately 22% over the IC engine-powered car in which Mod I will be tested, representing a half-way step from P-40 engines toward Final Program Objectives of the ASE Program. The next development phase will be the actual Mod I engine testing commencing in the end of 1980. (LCL)

9373 (CONF-800419—(Vol.1), pp 336-355) **Stirling Engine Systems: United Stirling's P-40 engine: three years' experience of testing, evaluation, and improvements.** Rosenqvist, K. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The development at KB Stirling (Sweden) of generations of Stirling engines for use in vehicles, heat pumps, solar thermal electric power systems, and in underwater operations is reviewed with information on component design, and engine operating and performance experience. (LCL)

9374 (CONF-800419—(Vol.1), pp 406-413) **Stirling Engine Systems: Stirling powered regenerative retarding propulsion system for automotive application.** Walker, G. (Calgary Univ., Alberta). Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The operation and applications of Stirling engines equipped with a thermal battery are discussed. The thermal battery would be a molten salt, probably lithium fluoride, and would be thermally coupled to the Stirling engine by means of a sodium heat pipe. Heat is supplied to the engine from the battery at temperatures of from 550 to 850°C. The engine can operate as a heat pump drawing heat from a cooling water loop and rejecting high temperature heat to the thermal battery. It can also operate by converting vehicular braking energy to heat which can be pumped to the thermal battery. In addition the thermal batteries can be charged overnight using heat from the combustion of a variety of non-petroleum fuels, including solid wastes. Application of the Stirling engine with thermal battery system to private, commercial, and industrial vehicles is forecast. (LCL)

9375 (CONF-800419—(Vol.1), pp 414-422) **Stirling Engine Systems: thermal analysis of reciprocating rod seals in the Stirling engine.** Hughes, W.F. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Sliding seals are a crucial component of the Stirling engine, being essential for oil-hydrogen separation and to prevent excessive leakage of either. The requirements for rod seals in the Stirling engine are more stringent than for conventional internal combustion engines where the piston rings themselves serve as the oil seals. The Stirling engine rod seals are subject to a severe environment, and a design which allows long effective seal life is one necessary goal before a practical engine can be manufactured. In order to better understand the operating conditions of these rod seals and develop useful design criteria, a thermal analysis of a typical rod seal configuration was studied. A mathematical model and analysis are discussed. A rather general configuration of a slider (Leningrader oil seal) and a dry cap hydrogen seal to be the main seal components were assumed.

9376 (CONF-800419—(Vol.1), pp 423-425) **Stirling Engine Systems: variable displacement Stirling automobile power trains.** Meijer, R.J. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The possibility of retrofitting a 2875-lb Oldsmobile Omega with a small Stirling engine and a simple 2-speed drive train to achieve an overall fuel economy of 54 mpg is described. Further down-scaling of the engine and drive to fit an 1800-lb car is predicted to result in an 85 mpg fuel economy. (LCL)

9377 (CONF-800419—(Vol.1), pp 455-469) **Materials technology: materials development for the automotive Stirling engine.** Petrovich, A. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Materials development, involving only metallic materials fabricated by standard methods, is in progress for the important components of the automotive Stirling engine. The results of these activities will contribute to the Mod II engine technology. Emphasis is being given to the selection and verification of heater head materials that do not contain cobalt. Several promising candidates have been identified, and they will be subjected to verification testing on a high-temperature P-40 engine. The need to consider wrought materials for the cylinder heads and regenerator housings has been indicated by high-temperature P-40 engine testing. Attention in the program is also being given to the air preheater, piston domes, hydrogen coolers, and other components.

3303 Electric-powered Systems

9378 **(DOE/NASA/1044—12) Design studies of continuously variable transmissions for electric vehicles.** Parker, R.J.; Loewenthal, S.H.; Fischer, G.K. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1981. Contract AI01-77CS51044. 18p. (NASA-TM—81642; CONF-810206—2). NTIS, PC A02/MF A01.

From Society of Automotive Engineers international engineering congress and exposition; Detroit, MI, USA (23 Feb 1981).

Preliminary design studies were performed on four continuously variable transmission (CVT) concepts for use in advanced electric vehicles. A 1700 kg (3750 lb) vehicle with an energy storage flywheel was specified. Requirements of the CVTs were a maximum torque of 450 N-m (330 lb-ft), a maximum output power of 75 kW (100 hp), and a flywheel speed range of 28,000 to 14,000 rpm. The design of each concept was carried through the design layout stage. Power losses were determined over the ranges of operating conditions, and transmission effficiencies were calculated. The design studies were performed under contracts to NASA for DOE by Garrett/AiResearch (toroidal traction CVT), Battelle Columbus Labs (steel V-belt CVT), Kumm Industries (flat belt variable diameter pulley CVT), and Bales-McCoin Tractionmatic (cone-roller traction CVT).

3304 Hybrid Systems

REFER ALSO TO CITATION(S) 9378

9379 (CONF-800419—(Vol.2), pp 600-614) **Vehicle systems: drive systems with brake-energy recovery.** Hagin, F.; Merker, P. (Maschinenfabrik, Augsburg-Nurnberg, Germany). Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Hybrid systems for the recovery of brake energy are intended for use in city buses. The standard city bus SL 200 gross vehicle weight of 16 tons with rear-mounted underfloor engine is an example of such a bus. The hybrid drive unit of the bus consists of a diesel engine with an infinitely variable speed transmission (hence IVT) and of an energy storage system (flywheel or hydraulic storage) connected to the IVT. During deceleration, the kinetic energy of the vehicle is transmitted from the wheels of the rear axle to the energy accumulator via IVT. In this way, the speed of the flywheel or the pressure in the high pressure accumulator is increased. During acceleration, the reverse process takes place. The diesel engine cuts in to compensate losses, i.e., to keep the total accumulated energy and kinetic energy of the bus at a constant level. At constant speed or on long inclines, the diesel engine preferably serves as the only drive unit. The design, operation, performance, and economics of a flywheel (Gyrobus) and of a hydraulic storage (Hydrobus) system installed on buses in West Berlin are discussed. First tests showed a 20% fuel savings with the Hybrobus. This is predicted to go to 25% versus a 20% fuel savings with the Gyrobus as compared with conventional engines. In spite of the extra equipment involved, the price and weight of either the Hydrobus or Gyrobus is only slightly greater than that of a conventional bus because the engine size is smaller. In addition to fuel savings, improved vehicle performance and reduced environmental pollution result from use of these hybrid systems. (LCL)

9380 **(UCRL—15301) Laminated composite disc flywheel development. Third interim report, July 1, 1979-January 10, 1980.** Nimmer, R.P.; Torossian, K.; Hickey, J. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.; General Electric Co., Schenectady, NY (USA). Materials and Processes Lab.). Feb 1980. Contract W-7405-ENG-48. 92p. NTIS, PC A05/MF A01.

Progress during the third reporting period (July 1, 1979 to January 10, 1980) of the Lawrence Livermore Laboratory Subcontract No. 2749309 for the development of a laminated, composite, flywheel disc for use in hybrid flywheel/electric-powered vehicles is discussed. The General Electric Company has developed and begun to optimize a concept based upon a laminated disc and a filament-wound outer ring assembled with an interference fit between these two components. The laminated, central disc is made of S2-glass-epoxy and the outer ring is filament-wound graphite-epoxy. Projections for this particular flywheel design indicate that it will be both practical and relatively inexpensive to produce, and that it will have a high energy-density capacity. Two hybrid composite flywheels of 37 cm O.D. were successfully assembled. This report summarizes the spin-test data actually gathered, discusses the nondestructive test data, and describes the fabrication techniques developed for the hybrid flywheel assembly. (LCL)

3306 Vehicle Design Factors

9381 (CONF-800419—(Vol.1), pp 82-95) **Market trends, projections, and applications: specifications of typical automobiles and light trucks in the 1985-1990 period.** Luchter, S. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

In the post 1985 period, a mix of automobile and light truck sizes is still expected to be available to the American consumer. The larger automobiles are expected to be shorter and lighter than today's vehicles. Little change is expected in the smaller automobiles except a two-passenger commuter car, is anticipated. A mini-van and redesigned pick-ups are expected in the light truck area. Some of the characteristics of the vehicles expected to comprise the bulk of the new vehicle fleet in the 1985-1990 period are quantified here. This preliminary estimate shows that the weight and fuel economy that automobiles and light trucks might achieve in the post-1985 period should result in average fuel economy values greater than 27.5 mpg for automobiles. Fuel economy increases beyond today's values also appear technologically feasible for light trucks. (LCL)

9382 (CONF-800419—(Vol.1), pp 569-576) **Vehicle systems: controlled speed accessory drive (CSAD) demonstration.** Courville, G.M. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The investigation of techniques for reducing the power required to drive automobile accessories has been one part of the US Department of Energy's effort in the area of improving fuel economy for highway passenger vehicles. One result of this investigation has been the development of a controlled speed accessory drive system acronymed CSAD, which has shown the potential for reducing the fuel consumption by 5 to 10 %. The program is structured to compile actual on-the-road driving data from a fleet of GSA vehicles at varied sites with different environmental conditions. A summary of the results, even allowing for many operational variables, showed an overall percent improvement in fuel economy of more than 6 %. (LCL)

3307 Emission Control

REFER ALSO TO CITATION(S) 9264, 9339, 9359, 9360, 9361, 9362, 9368, 9527

9383 **(AD-A—084933) Exhaust emissions characteristics for a general aviation light-aircraft Avco Lycoming 0-320/IO-330-DIAD piston engine. Final report.** Becker, E.E. (National Aviation Facilities Experimental Center, Atlantic City, NJ (USA)). Apr 1980. 124p. NTIS, PC A06/MF A01.

The Avco Lycoming 0-320/IO-320-DIAD engine (S/N889-X) was tested at the National Aviation Facilities Experimental Center (NAFEC) to develop an exhaust emissions data base. This data base consists of current production baseline emissions characteristics, lean-out emissions data, effects of leaning-out the fuel schedule on cylinder head temperatures, and data showing ambient effects on exhaust emissions and cylinder head temperatures. The engine operating with its current full-rich production fuel schedule could not meet the proposed Environmental Protection Agency (EPA) standard for carbon monoxide (CO) under sea level standard-day conditions. The engine did, however, meet the proposed EPA standards for unburned hydrocarbons (HC) and oxides of ni-

trogen (NO(x)) under sea level standard-day conditions. The results of engine testing under different ambient conditions are also presented, and these results show a trend toward higher levels of emissions output for CO and HC under warm-or hot-day conditions while producing slightly lower levels of NO(x).

9384 (CONF-800419—(Vol.2), pp 627-636) **Diesel engine advances: controlling diesel engine particulate emissions.** Gorman, R. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The possibility of using a mini-baghouse, i.e., fiberglass flow-through bag, to filter the fine, potentially carcinogenic, particles emitted from automotive diesel engines is discussed and initial tests on a rudimentary filter are described. (LCL)

9385 (CONF-800419—(Vol.2), pp 636-651) **Diesel engine advances: instantaneous diesel exhaust opacity.** Kizawa, H.; Ferguson, C.R. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Since particles emitted by diesel engines are probably carcinogenic, it becomes important to quantify the amount of such particles emitted in order to estimate the public health risk of automotive diesel engines. Results from first attempts to measure the instantaneous particulate emission from a diesel engine, the optical equipment used to measure instantaneous diesel exhaust opacity, and a theoretical analysis of opacity that is used to interpret the experimental results are discussed. (LCL)

9386 (CONF-800419—(Vol.2), pp 809-826) **Engine fuel relationships: effect of fuel properties on the time resolved soot particulates in a simulated diesel spray.** Kadota, T.; Henein, N.A.; Lee, D.U. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The effect of fuel properties on the mass concentration of soot particles at different stages of diesel spray combustion was investigated experimentally. Since fuel modification is one of the techniques to reduce the soot particulates in diesel engines, it was attempted to study the effect of mixing diesel fuel No. 2 with other available fuels of low smoking tendency on the reduction of soot particulates. Also, the effect of adding water to diesel fuel No. 2 was investigated. The design and operation of the experimental equipment are described. The parameters studied are enumerated. Differences between the simulated diesel spray combustion in the experiments and spray combustion in diesel engines are discussed. The experimental results are presented. The primary conclusions were: for all the fuels tested, the mass concentration of the soot particulate shows a maximum as a function of the time from the start of injection; and mixing the diesel fuel No. 2 with methanol, ethanol, indolene, or water has a definite effect on reducing the rate of formation and the maximum concentration of soot particulates in the flame. Mixing with water produced the lowest maximum soot particulates. (LCL)

9387 **(DOE/NASA/1011—33) Ultra-lean combustion at high inlet temperatures.** Anderson, D.N. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1981. Contract AT01-76CS51011. 20p. (NASA-TM—81640; CONF-810309—5). NTIS, PC A02/MF A01.

From ASME gas turbine conference; Houston, TX, USA (9 Mar 1981).

Combustion at inlet-air temperatures of 1100 to 1250°K was studied for application to advanced automotive gas turbine engines. Combustion was initiated by the hot environment, and therefore no external ignition source was used. Combustion was stabilized without a flameholder. The tests were performed in a 12-cm-diameter test section at a pressure of 2.5 x 10^5 Pa, with reference velocities of 32 to 60 m/s and at maximum combustion temperatures of 1350 to 1850°K. Number 2 diesel fuel was injected by means of a multiple-source fuel injector. Unburned hydrocarbons emissions were negligible for all test conditions. Nitrogen oxides emissions were less than 1.9 g NO_2/kg fuel for combustion temperatures below 1680°K. Carbon monoxide emissions were less than 16 g CO/kg fuel for combustion temperatures greater than 1600°K, inlet-air temperatures higher than 1150°K, and residence times greater than 4.3 ms.

3308 Alternative Fuels

9388 (CONF-800419—(Vol.1), pp 43-46) **Role of technology for tomorrow's transportation: fuels.** Herman, M.J. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Some comments are presented on the current energy policy with respect to liquid fuels, the current status of the alcohol fuels industry, and the outlook for utilization of alcohol fuels in the transportation sector are presented. (RCK)

9389 (CONF-800419—(Vol.2), pp 802-808) **Engine fuel relationships: fuel/engine compatibility.** Ecklund, E.E. (Dept. of Energy, Washington, DC). Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Systems requirements for fuel/engine compatibility, US DOE policy and activities for developing alternative and synthetic fuels for vehicles, and the need for industry/policy-maker cooperation for the commercialization of non-petroleum-based fuels are discussed. (LCL)

9390 (CONF-800419—(Vol.2), pp 847-889) **Alternative fuels: Canadian alternative transportation fuel options in the 1980's-1990's: a summary of current R & D activities in the automotive use of broad-cut fuels, methanol, propane, and electricity.** DelVecchio, R.; Maund, G.B.; Taylor, A.C. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Canadian sources of fuels for transportation systems, the transportation sector fuel consumption, and activities related to alternative fuels are discussed. It was concluded that Canada is rich in alternative fuels from both fossil sources and renewable sources. Methanol is a liquid fuel of acceptable energy density and has the attraction of utilizing the carbon and hydrogen components from natural gas, coal, peat, and biomass, which, although present in differing quantities across Canada, could supply methanol at viable costs in the 1990's. Diverse choices of acceptably high energy density liquid fuels exist, but only gasoline has an established supply system. Current activities are directed to selecting an alternative fuel and supply system principally to meet road transport demands by examining the possible fuel and engine systems to be in place by 1995. Fuel/engine systems studies have been mounted to evaluate some of these options and are planned to cover a range of synthetic gasoline and alchohol based options while keeping in mind the need for uniformity of supply or engine adaptability to maintain transcontinental mobility.

9391 (CONF-800419—(Vol.2), pp 890-899) **Alternative fuels: performance evaluation of alcohol-gasoline blends in late model automobiles.** Carlson, R.E. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

A program for experimentaly evaluating the effects of enthanol and methanol in gasoline on exhaust emissions of HC, CO, NO/sub x/, aldehydes, ethanol, and methanol; evaporative emissions of HC, ethanol, and methanol; and vehicle driveability is described. The scope of work includes the following: purchase 14 specified test vehicles; mechanically inspect and repair them, if needed; accumulate 4000 miles using a surface and freeway driving schedule; blend and laboratory test twenty-four candidate methanol-gasoline fuel blends; demonstrate testing and analytical procedures; conduct emissions, fuel economy, and driveability testing; and report and analyze the test data. The vehicles have been acquired, prepared, and operated for 4000 mile breakin. Demonstration testing is in progress. (LCL)

9392 (CONF-800419—(Vol.2), pp 931-951) **Alternative fuels: oxygen sensor equipped engine operation on phase separated methanol/gasoline blends.** Lawson, A.; Last, A.J.; Mackay, D.; Tsang, M.; Maund, G.B. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

This program addresses problems related to Canadian utilization of methanol/gasoline blends. Phase I of this project has the following objectives: to examine the feasibility that an in-fuel-line mechanical emulsifier (the ORF HydroShear) can be used to make an unstabilized emulsion of both phases in a phase separated methanol/gasoline blend and combust this emulsion successfully in the engine through fuel management design; to generate fuel maps, by engine dynamometer testing, with methanol/gasoline blends containing 15% to 80% methanol; and to examine the capability of an oxygen sensor, located in the exhaust system, to control the fuel/air ratio when the engine is operated on 15% to 80% methanol/gasoline blends. Two vehicles are being used in the project: a fuel injected, Volvo 244DL with lambda-sond emission control system and a carburetted Chevrolet Monza with 3-way catalyst, closed-loop feedback emission control system. Experimental data on engine performance and exhaust emissions for varying fuel mixtures are presented. Work on the phase separation control system is continuing. (LCL)

9393 (CONF-800419—(Vol.2), pp 953-973) **Alternative fuels: hydrogen engine and fuel containment R and D: a progress report on the US Department of Energy program.** Escher, W.; Adt. R. Jr.;Swain, M.; Pappas, J.; Rohy, D.; Stewart, W.; Peschka, W. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

A US DOE research program planned to demonstrate by 1990 the operating, performance, and emission characteristics of an hydrogen-fueled automobile and its associated on-board hydrogen storage system is discussed with information on the project status, test facilities, performance analysis, anticipated benefits of a hydrogen-fueled vehicle, and continuing investigations. (LCL)

9394 (CONF-800419—(Vol.2), pp 974-996) **Alternative fuels: use of hydrides in motor vehicles.** Buchner, B.; Toepler, D.B. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Past research has demonstrated that spark ignition engines in vehicles can be changed over to operate on hydrogen. The advantages of such operation include conservation of petroleum-based automotive fuels and practically pollution-free engine exhaust gases. The development of hydrogen storage systems for vehicles is of primary importance. The characteristics of metal hydrides for hydrogen storage systems are discussed with information on low- and high-temperature hydrides; the concept of storage units heated by engine exhaust gases, by water, and by auxiliary burner, and demonstration programs on hydrogen-fueled vehicles with hydride storage units. (LCL)

9395 (CONF-800419—(Vol.2), pp 997-1008) **Alternative fuels: the part of Volkswagenwerk AG in the Germany program for research on alcohol fuels.** Menrad, H. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Research programs in West Germany on the use of pure alcohol, pure methane, gasohol, and alcohol-diesel fuel mixtures are reviewed. Some emission testing and performance testing data for engines operating on these fuels are included. (LCL)

9396 (CONF-800419—(Vol.2), pp 1009-1021) **Alternative fuels: Canadian diesel fuel supply as influenced by refinery and engine constraints.** Currie, T.; Whyte, R.B. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

A two-part study was commissioned by Transport Canada to investigate the feasibility of operating the current breed of automotive diesel engines on gasoline-diesel fuel mixtures and to determine to what extent future supplies of automotive diesel fuel could be increased by broadening the diesel cut (to include more naphtha) and for relaxing minimum cetane number specifications. Dynamometer tests on six fuel mixes in a VW Rabbit diesel engine and in a GMC pick-up truck diesel engine are described and the test results are presented. These test results indicate that broad-cut diesel fuels with initial boiling points as low as 95°C perform satisfactorily in typical automotive diesel engines. The results also indicate that low temperature operability, an important consideration for most Canadian diesel users, is probably better with these fuels than it is with No. 2 diesel fuel. Since Canadian diesel fuels will, undoubtedly, be produced with lower cetane numbers in the future than at present as the use of synthetic crudes in Canadian refineries increases, more volatile diesel fuels may be required to ensure adequate cold-starting performance. Finally, broadening the diesel cut to include more naphtha would permit refineries to operate at lower gasoline/distillate ratios than is presently possible. (LCL)

9397 (CONF-800419—(Vol.2), pp 1022-1035) **Alternative fuels: ethanol as a substitute fuel for automotive engines.** Sivaligam, P. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

Experience in India with the operation of ethanol-fueled automotive engine testing is summarized. Tests results are presented for fuel consumption and engine performance for spark-ignition (S.I.) engines fuel with gasoline and with ethanol and for a diesel (C.I.) engine fueled with an ethanol-diesel fuel mixture. Tests conducted on multi-cylinder S.I. engines fitted to Indian-made automobiles confirm that it is possible to run them with few modifications on neat hydrated ethanol. However, to obtain comparable fuel economy and good driveability, further modifications such as increasing the compression ratio and incorporation of heat exchangers may be necessary. If this could be accomplished with least expenditure, it will pave the way for gradual conversion of existing petroleum engines into ethanol engines. Controlled heating and a balanced induction manifold system are likely to improve the performance of a multi-cylinder automotive C.I. engine. (LCL)

9398 (LA-UR—80-3491) **Liquid-hydrogen automotive onboard storage and servicing system project: a progress report.** Stewart, W.F.; Escher, W.J.D. (Escher Technology Associates, St. Johns, MI (USA); Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 8p. (CONF-810206—4). NTIS, PC A02/MF A01.

From Society of Automotive Engineers international engineering congress and exposition; Detroit, MI, USA (23 Feb 1981).

Under Department of Energy sponsorship, the Los Alamos Scientific Laboratory is presently road testing a US intermediate sized automobile adapted to liquid-hydrogen fuel. The overall project objective is to document a general experience base as a point of departure for future development. A semiautomatic fueling station developed by the Deutsche Forschungs-und Versuchsanstalt fuer Luft- und Raumfahrt (DFVLR) of the Federal Republic of Germany is being used to service (refuel) the experimental vehicle. The DFVLR also provided the 150-l (39.6-gal.) cryogenic liquid-hydrogen storage tank mounted in the trunk compartment and the dashboard fuel gauging system. The V-6 turbocharged engine was converted to hydrogen operation by the Billings Energy Corporation. Both the container and the engine modifications represented state-of-the-art technology when the program began.

36 MATERIALS

9399 (COO—2296-22) **Diffusional creep of multicomponent systems. Progress report, February 1, 1980-January 31, 1981.** Li, J.C.M. (Rochester Univ., NY (USA)). 1981. Contract AS02-76ER02296. 21p. NTIS, PC A02/MF A01.

Topics for which significant results are reported include dislocation-crack interactions, impression creep of Al polycrystals, and photoplastic and electroplastic effects in additively colored KCl. 9 figures. (DLC)

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 8529, 8536, 8539, 8539, 8542, 8796, 9062.

9113, 9116, 9119, 9466, 9504, 9504, 9522, 10015, 10015

9400 (AD-A—084943) Study of materials having significance for high energy magnet production and hydrogen storage. Final report, 1 March 1977-29 February 1980. Wallace, W.E. (Pittsburgh Univ., PA (USA). Dept. of Chemistry). 15 May 1980. 23p. NTIS, PC A02/MF A01.

A summary is given of work dealing with the development of new permanent magnet materials and new materials for hydrogen storage. The work is reported in detail in 39 publications which have appeared or will appear in the open literature. These include 10 reviews of the subject matter of the program. Among the most significant findings are the following: (1) hydrogen in rare earth and actinide intermetallics behaves as if it were anionic; (2) hydrogenation can either 'switch off' or 'switch on' ferromagnetism, depending on the system; (3) the superconductor Th7Fe3 is converted into a ferromagnet when hydrogenated; (4) the mechanism of hydrogen uptake has been thoroughly elucidated; (5) Er2Co17 and Yb2Co17-based systems have been identified as potentially useful permanent magnet materials; (5) Cr sub-stitution for Co in Sm2Co17 has a powerful beneficial effect on anisotropy.

9401 (DOE/ER/10367—T1) Criterion for the prevention of core fracture during extrusion of bimetal rods. Avitzur, B.; Wu, R.; Talbert, S.; Chou, Y.T. (Lehigh Univ., Bethlehem, PA (USA). Inst. for Metal Forming). Sep 1980. Contract AC02-79ER10367. 50p. NTIS, PC A03/MF A01.

Based on the upper-bound theorem in limit analysis, a theoretical model for core fracture in bimetal rods during extrusion has been developed and a fracture criterion established. The variables affecting core fracture are: reduction in area (r%), die geometry, friction (m), relative size of the core and relative strength of the core. Within the wide range of possible combinations of these process variables, only a small range permits extrusion without fracture. With suitable modifications the present analysis can be extended to develop criteria for sleeve fracture during extrusion and for both core and sleeve fracture during drawing.

9402 (DOE/ER/10367—T2) Criterion for the prevention of core fracture during extrusion of bimetal rods. Avitzur, B.; Wu, R.; Talbert, S.; Chou, Y.T. (Lehigh Univ., Bethlehem, PA (USA). Inst. for Metal Forming). Sep 1980. Contract AC02-79ER10367. 50p. NTIS, PC A03/MF A01.

Based on the upper-bound theorem in limit analysis, a theoretical model for core fracture in bimetal rods during extrusion has been developed and a fracture criterion established. The variables affecting core fracture are: reduction in area (r%), die geometry, friction (m), relative size of the core and relative strength of the core. Within the wide range of possible combinations of these process variables, only a small range permits extrusion without fracture. With suitable modifications the present analysis can be extended to develop criteria for sleeve fracture during extrusion and for both core and sleeve fracture during drawing.

9403 (DOE/ER/10367—T3) Upper-bound solutions to flow through conical converging dies. Avitzur, B.; Narayan, C.; Chou, Y.T. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Metallurgy and Materials Engineering). Sep 1980. Contract AC02-79ER10367. 43p. NTIS, PC A03/MF A01.

Limit analysis is a very versatile modeling technique that can be used to study metal-forming processes. The upper-bound analysis can be used to predict an upper limit on the power requirements. This work reviews some upper-bound solutions that describe flow through conical converging dies. The concept of a trapezoidal field is introduced and dealt with in great detail, and the power requirements based on the trapezoidal field are calculated. Results are compared with those obtained using spherical and triangular fields. The relative stress expression has been developed analytically and the final optimization with respect to the pseudoindependent parameter is done numerically. The trapezoidal field predicts a lower upper-bound solution for small semicone angles. The range over which the trapezoidal field solution becomes dominant increases with increasing friction factor.

9404 (DOE/ER/10507—1) Fundamental investigations of the oxidation of alloys in multicomponent gaseous environments. Annual technical progress report, 1 September 1979-31 October 1980. Yurek, G.J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). 28 Oct 1980. Contract AC02-79ER10507. 14p. NTIS, PC A02/MF A01.

A gas mixing system and an apparatus for TGA has been developed for oxidation or sulfidation experiments in various mixtures of H_2, H_2O, H_2S and Ar. The system can be adapted easily to include C-bearing gases in the future. According to preliminary experiments, Cr exhibits oxidation rate anisotropy, the slowest growing scales being found on the (110) planes of Cr. Oxidation of Cr single crystal disks having faces nearly parallel to (100) planes of Cr yields a very fine grained Cr_2O_3 scale that contains pores and has a pitted surface. The density of the oxide is apparently less than the theoretical density of Cr_2O_3. The oxidation of Cr disks in the $H_2/H_2O/H_2S$ mixture at the same P/sub O2/ yielded a denser oxide with somewhat larger grains and less pitting at the surface. The oxide contains nearly spherical second phase precipitates, which may be metastable CrS.

9405 (DOE/ER/10571—2) Radiation effects in amorphous Fe/sub x/Ni/sub 80-x/$P_{14}B_6$. Franz, W.T.; Steck, G.; Kramer, J.J.; Murray, R.B.; Onn, D.G. (Delaware Univ., Newark (USA)). 1980. Contract AC02-80ER10571. 10p. NTIS, PC A02/MF A01.

Changes in the Curie temperature and magnetic saturation of the amorphous ferromagnetic series Fe/sub x/Ni/sub 80-x/$P_{14}B_6$ for $20 \leqq x \leqq 34$ induced by proton bombardment have been studied, and correlated with small angle x-ray scattering measurements performed for $x = 20$ at Oak Ridge National Laboratory. Both the Curie temperature and the low temperature saturation magnetization increase with proton fluence up to 10^{16} cm^{-2} but are constant for higher fluences. Protons of energy 2.25 MeV (range much greater than the sample thickness) are more effective at producing changes than protons of energy 0.25 MeV (range much less than sample thickness). Thus, hydrogen implantation is eliminated as the principal source of the observed changes. In addition, careful attention to sample temperature during irradiation excludes thermal annealing as the origin of the effect. Proton bombardment at the same fluences produces scattering centers that are observed by small angle x-ray scattering. The concentration of scattering centers increases with proton fluence up to 10^{16} cm^{-2}, but remains constant thereafter. The size of the centers remains constant at about 16 to 30 A. Possible structural changes to account for these observations are incipient recrystallization, void formation, and phosphorous segregation.

9406 (DOE/ET/11296—T16) Heat exchanger fouling and corrosion evaluation. Phase 1, topical report exhibit III-B. Kindlimann, L.; Silvestrini, R. (AiResearch Mfg. Co., Los Angeles, CA (USA)). 30 Apr 1979. Contract AC03-77ET11296. 32p. NTIS, PC A03/MF A01.

This report is a summary of the results of Tasks 3 and 4 which conclude the Phase 1 portion of this program. Tasks 1 and 2 were summarized in AiResearch Report 78-15161. Task 3, entitled Materials Evaluation, is a laboratory evaluation of candidate materials and coatings exposed to various H_2SO_4 environments; the evaluation includes the determination of a corrosion rate from the field test modules. Task 4, entitled Fouling Evaluation, is an evaluation of the fouling rates of different heat exchanger surface configurations exposed to different diesel exhaust conditions.

9407 (DOE/ET/13513—T5) Embrittlement of Cr-Mo steels in H_2S plus H_2O vapor environment. Quarterly report No. 8, May 15-August 15, 1980. Shaw, B.J. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 28 Nov 1980. Contract AC05-78ET13513. 21p. NTIS, PC A02/MF A01.

Results from previous quarterly periods are summarized. A series of tests on 2 1/4 Cr-1 Mo and 1 1/4 Cr-1/2 Mo steels was conducted in 50 psig H_2S saturated with water vapor. 6 figures. (DLC)

9408 (DOE/FF/02170—T58) Development of an irradiation creep correlation for 20% cold-worked AISI 316 in fusion environments: DAFS contribution. Doran, D.G. (Hanford Engineering Development Lab., Richland, WA (USA)). 1980. Contract AC14-76FF02170. 12p. NTIS, PC A02/MF A01.

A correlation has been developed describing the anticipated irradiation creep behavior of 20% cold-worked AISI 316 in fusion environments. It incorporates low temperature fast breeder and thermal reactor data to extend the existing breeder correlation to the temperature range of the proposed Fusion Energy Device. It also includes a dependence on displacement rate not currently incorporated in the corresponding breeder correlation.

9409 (IS-M—305) Preparation of high purity vanadium. Carlson, O.N.; Burkholder, H.R.; Martsching, G.A.; Schmidt, F.A. (Ames Lab., IA (USA)). 1981. Contract W-7405-ENG-82. 13p. (CONF-810203—1). NTIS, PC A02/MF A01.

From Extraction metallurgy of refractory metals meeting; Chicago, IL, USA (22 Feb 1981).

The paper reviews the various reduction and refining methods that have been used to prepare vanadium metal. Earlier work on metallothermic and carbothermic reduction processes is discussed. Recent work on improving the scaling up the aluminothermic reduction process is described in detail. Iron and silicon are first removed from commercial V_2O_5 by an ion exchange separation technique and the purified oxide is then exothermically reduced with aluminum metal. The resulting V-Al ingot is heated in a vacuum to 1700°C to remove the aluminum and dissolved oxygen, and the sponge is then electron-beam melted to remove residual volatile impurities to yield vanadium metal of 99.98% purity. Precautions taken during each processing stage to minimize carbon, nitrogen and oxygen contamination are described. Metal containing $<$ 50 ppmw each of C, N and O, $<$ 20 ppmw Si, and $<$ 10 ppmw of Fe and Al has been prepared in kilogram quantities by this method. The hardness of the beam melted is 60 to 70 DPH. Experiments designed to scale up the reduction process and to increase the efficiency of the separation and melting steps are described. Various refining techniques that have been applied to the preparation of high purity vanadium are described and comparisons made between the quality of metal obtained by each.

9410 (LBL—11341) Platelet mechanism of erosion of ductile metals. Bellman, R. Jr.; Levy, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1980. Contract W-7405-ENG-48. 17p. (CONF-810301—1). NTIS, PC A02/MF A01.

From International conference on wear of materials; San Francisco, CA, USA (31 Mar 1981).

The removal of material from the surface of a ductile metal by small impacting particles is a design concern to the builders of synthetic fuels plants that utilize pulverized coal to produce gaseous forms of fuel. A series of room temperature experiments was conducted to determine the mechanism of material removal when an erosive particle stream impacts on a ductile metal surface. 1100-0 and 7075-T6 aluminum were used for the target and 600 μm SiC particles moving at a velocity of 100 fps in air were used for the eroding stream. It was determined that a combined forging-extrusion mechanism that produces small, highly distressed platelets of target material that are knocked off the surface by succeeding particle impacts is responsible for erosion at both low and high impingement angles. The large strains that produce the platelets occur in a thin surface region which is heated near or to the annealing temperature of the metal as a result of adiabatic shear deformation. Beneath the soft surface layer is a region that has been cold worked by impact particle induced plastic deformation. This hard, sub-surface layer, once formed, increases the efficiency of platelet formation at the surface and the erosion rate increases to a constant level. This proposed mechanism is a significant departure from the previously believed micro-machining mechanism of erosion of ductile metals. 16 figures.

9411 (LBL—11680) Microstructure and properties of step aged rare earth alloy magnets. Mishra, R.K.; Thomas, G.; Yoneyama, T.; Fukuno, A.; Ojima, T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; TDK Electronics Co. Ltd., Ichikawa (Japan). R and D Lab.). Nov 1980. Contract W-7405-ENG-48. 6p. (CONF-801134—13). NTIS, PC A02/MF A01.

From 26. annual conference on magnetism and magnetic metals; Dallas, TX, USA (11 Nov 1980).

Alloys with compositions Co-25.5 wt/o Sm-8 w/o Cu-15 w/o Fe-3 w/o Zr and Co-Sm-Cu-Fe-1.5 w/o Zr have been step aged to produce magnets with coercive force (iHc) in the range of 10 to 25k0e. The high coercive force magnets are typically aged at 800 to 850°C for 10 to 30 hours following the solution treatment at 1150°C. Subsequently, these are step aged to produce materials with high coercivity. The microstructure in all these alloys has a 2 phase cellular morphology with 2:17 phase surrounded by a 1:5 boundary phase. The long aging treatments at 800 to 850°C lead to coarsening of the two phase structure. The subsequent step-aging does not change the morphology, but only changes the chemical composition of the two phases. Best properties are obtained in materials with a coherent microstructure of optimum boundary phase thickness and optimum chemical composition. The highest values of iHc obtained so far are $\sim$ 26k0e and $\sim$ 16 k0e for the 3% Zr and 1.5% Zr alloys respectively. The best hard magnetic properties of (BH) max = 33 MG0e and iHc = 13k0e are for a 25% Sm-20% Fe-4 Cu-2% Zr alloy.

9412 (ND-R—471(R)) Life prediction methods for the combined creep-fatigue endurance. Lloyd, G.J.; Wareing, J. (UKAEA Risley Nuclear Power Development Establishment). Sep 1980. 26p. NTIS (US Sales Only), PC A03/MF A01.

Consideration of the prediction methods available for the combined creep-fatigue endurance has shown that there has been an evolution in their general development. In addition to the historically conventional linear damage methods which predict the total endurance at failure, there are methods emerging, based on crack propagation, which consider in more detail the path dependence and rate of development of failure. However, it is still required to evaluate all methods more extensively against data obtained using material which reflects service degradation and dwell periods which are representative of service. The very difficult problem of assessing the validity of the application of uniaxial creep-fatigue data and damage rules to practical circumstances of multiaxial stress-strain states has not yet been tackled in any systematic manner. 32 references, 11 figures.

9413 (SAND—80-1177C) Interaction between computational modelling and experiments for vacuum consumable arc remelting. Bertram, L.A.; Zanner, F.J. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 18p. (CONF-800881—2). NTIS, PC A02/MF A01.

From Conference on modeling of casting and welding processes; Runge, NH, USA (Aug 1980).

Portions of document are illegible.

A combined computational-experimental modelling effort is currently underway to characterize the vacuum consumable arc remelt process. This effort involves the coupling of experimental results with a magnetohydrodynamic flow model which is capable of time accurate solutions of the interdependent fluid flow-solidification process in the ingot. Models such as this are driven by boundary conditions. Considerable data have been compiled from direct observation of the electrode tip and molten pool surface by means of high speed photography in order to gain an understanding of the processes at the pool surface and the appropriate corresponding boundary conditions. The crucible wall/molten metal miniscus conditions are less well understood. Pool volumes are computed at different melting currents and show reasonable agreement with experimentally determined values. Current flow through the ingot is evaluated numerically and the results indicate that a significant portion of the melt current does not reach the interior of the ingot. U-6 wt. % Nb alloy was used.

9414 (UCRL—84976) Electroless nickel: an important coating for diamond turning applications. Dini, J.W. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 24 Sep 1980. Contract W-7405-ENG-48. 16p. (CONF-810302—1). NTIS, PC A02/MF A01.

From Electroless nickel II conference; Cincinnati, OH, USA (17 Mar 1981).

Diamond turning is the use of a single-point diamond tool on a precision lathe under very precisely controlled machine and environmental conditions to fabricate finished components. With a machine presently available at LLNL a part accuracy between 0.05 and 1.0 μm (2 and 40 millionths of an inch) is obtainable. Coatings offer significant advantages for diamond turning applications inasmuch as they can be applied to lightweight substrates such as aluminum or beryllium. One of the most used coatings for diamond turning applications is electroless nickel. Purpose of this paper is to document case histories of such applications and suggest areas for future work.

9415 Charge-imbalance relaxation in the presence of a pair-breaking interaction in superconducting AlEr films. Lemberger, T.R.; Clarke, J. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter (U.S.);* **23**: No. 3, 1088-1099(1 Feb 1981).

The charge-imbalance relaxation rate, 1/F*tau/sub Q/*, has been measured in dirty superconducting AlEr films in which Er is a pair-breaking magnetic impurity that induces charge relaxation through elastic exchange scattering. Measurements were made in the range 0.1< or ≈Δ(T)/k/sub B/T/sub c/< or ≈1.4 for Er concentrations varying from 21 to 1660 at. ppm that produced estimated exchange scattering rates, tau⁻¹/sub S/, from about 10^9 sec^{-1} to 5 x 10^{10} sec^{-1}. Measured values of 1/F*tau/sub Q/* were in good agreement with the Schmid-Schoen expression, 1/F*tau/sub Q/*=(piΔ/4k/sub B/T/sub c/tau/sub E/) (1+2tau/sub E//tau/sub S/)/sup 1/2/, for Δ/k/sub B/T/sub c/< or ≈0.8, where tau⁻¹/sub E/ is the electron-phonon scattering rate estimated from the measured transition temperature. For larger values of Δ/k/sub B/T/sub c/, the relaxation rate increased less rapidly with Δ. The appropriate Boltzmann equation was solved on a computer to obtain values for 1/F*tau/sub Q/* in the range 0.5< or =T/T/sub c/< or =0.999 999. The computed values of 1/F*tau/sub Q/* agreed with several analytic expressions valid for Δ/k/sub B/T/sub c/<<1, but not with the experimental data: The computed curves increased more rapidly than linearly with Δ/k/sub B/T/sub c/ near T/sub c/, and the shape of the 1/F*tau/sub Q/* vs Δ/k/sub B/T/sub c/ curves was qualitatively different. This discrepancy suggests that either the generally accepted expression for exchange charge relaxation is incorrect, or that the Boltzmann equation is inappropriate for these calculations.

9416 Charge-imbalance relaxation in the presence of a pair-breaking supercurrent in dirty, superconducting Al films. Lemberger, T.R.; Clarke, J. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter (U.S.);* **23**: No. 3, 1100-1105(1 Feb 1981).

The charge-imbalance relaxation rate, 1/F*tau/sub Q/*, has been measured in dirty Al films in the presence of an applied supercurrent for 0.7< or ≈T/T/sub c/< or ≈0.91. The supercurrent I/sub s/ induces an anisotropic energy gap, and hence allows elastic scattering to relax the charge imbalance. The effect of a supercurrent is equivalent to that of magnetic impurities, with a pair-breaking rate tau⁻¹/sub s/=1/2D(p/sub s//h)², where D is the electron diffusion constant and p/sub s/ is the momentum of a Cooper pair. The measured relaxation time, F*tau/sub Q/*, is found to depend on I/sub s/ through the relation, F*tau/sub Q/*(I/sub s/)=F*tau/sub Q/*(O)/(1+bI²/sub s/)/sup 1/2/, where b is a function of T/T/sub c/. The measured temperature dependence of b is consistent with previous measurements of 1/F*tau/sub Q/* in AlEr films, in which the Er is a pair-breaking magnetic impurity, and with the Schmid-Schoen theory. The measured magnitude of b is in good agreement with the value expected from measured sample parameters. As with the data on AlEr, the measured value of b is not consistent with results based on a numerical solution of the Boltzmann equation.

9417 Local-density-functional approach to the isostructural γ-α transition in cerium using the self-consistent linearized-augmented-plane-wave method. Pickett, W.E.; Freeman, A.J.; Koelling, D.D. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60201). *Physical Review [Section] B: Condensed Matter (U.S.);* **23**: No. 3, 1266-1291(1 Feb 198[illegible]).

The isostructural γ-α phase transition of Ce which occurs at 8 kbar has been studied by means of fully self-consistent (nonmuffin-tin potential) linearized-augmented-plane-wave energy band calculations carried out for five different values of the lattice constant. In contradiction to the 4f electron promotional model of the transition, the results yield essentially one 4f electron to be occupied in each phase but with the 4f wave function somewhat less localized, and therefore more bandlike, in the "collapsed" α phase. A singly occupied 4f state is shown to be consistent with the available experimental data. These results strongly support the picture of a 4f localized bold-arrow-left-right itinerant transition at the γ-α transition and conflict with the promotional model in which some fraction of 4f electrons are transferred to the sd conduction bands. The weaker bonding of the 4f electrons, compared to that of the 6s-5d valence electrons, accounts for α-Ce appearing to have 3.5—3.7 bonding electrons in some respects. Calculation of the superconducting transition temperature T/sub c/ suggests that a small spin-fluctuation contribution detrimental to superconductivity is necessary to account for the very low value of T/sub c/ in α-Ce. Comparison with specific-heat data also suggests a spin-fluctuation contribution to the effective mass; susceptibility data point to a moderate exchange enhancement in α-Ce. We calculate a spin-susceptibility (Stoner) enhancement that increases with temperature, in agreement with experiment up to 150 K, and which tends to diverge at higher temperatures. Certain experiments are suggested which could help greatly in understanding further some important characteristics of the α phase.

9418 Fermi surface and many-body enhancement in Pd. Dye, D.H.; Campbell, S.A.; Crabtree, G.W.; Ketterson, J.B.; Sandesara, N.B.; Vuillemin, J.J. (Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Physical Review [Section] B: Condensed Matter (U.S.);* **23**: No. 2, 462-473(15 Jan 1981).

A Korringa-Kohn-Rostoker phase-shift parametrization of the Fermi-surface geometry and Fermi velocities in Pd is presented based on new measurements of cyclotron orbital areas and effective masses using the de Haas—van Alphen effect in fields up to 13.2 T and temperatures down to 0.35 K. We report accurate symmetry direction areas on all four sheets of the surface and new mass and area measurements on the open-hole sheet and L pockets. Comparison is made to band-theory radii and velocities, and enhancement effects due to electron-phonon, electron-electron, and electron-paramagnon interactions are discussed.

9419 Location of deuterium in α-yttrium. Khatamian, D.; Stassis, C.; Beaudry, B.J. (Ames Laboratory, U. S. Department of Energy, Iowa State University, Ames, Iowa 50011). W-7405-ENG-82. *Physical Review [Section] B: Condensed Matter (U.S.);* **23**: No. 2, 624-627(15 Jan 1981).

Neutron-diffraction techniques have been used to assess the deuterium location in a single crystal of α-yttrium. We find that in the α phase of YD/sub x/ (x=0.176) the deuterium atoms occupy predominantly the tetrahedral sites of the hcp lattice. The isotropic temperature factor of yttrium, obtained in the present experiment, is found to be smaller than that of pure yttrium. This result indicates that the addition of deuterium hardens the phonon frequency spectrum of the host metal.

9420 Surface-enhanced second-harmonic generation. Chen, C.K.; de Castro, A.R.B.; Shen, Y.R. (Department of Physics, University of California, Berkeley, California 94720). W-7405-ENG-48. *Physical Review Letters (U.S.);* **46**: No. 2, 145-148(12 Jan 1981).

Second-harmonic generation at a silver-air interface was enhanced by a factor of 10^4 by surface roughness. The local-field enhancement is believed to be responsible for the effect. An unusually broad luminescence background extending far beyond the anti-Stokes side of the second harmonic was also observed.

9421 Phase transformations in americium at high pressure: Relation to rare earth elements. Akella, J.; Johnson, Q.; Schock, R.N. (Lawrence Livermore Laboratory, Livermore, California 94550). *Journal of Geophysical Research (U.S.);* **85**: No. B13, 7056-7058(10 Dec 1980).

The crystal structure of ^{241}Am has been investigated up to 18.0 GPa, using a diamond anvil high-pressure apparatus. The normal dhep form of Am, stable at 1 atm and room temperature, undergoes three-phase transformations below 18.0 GPa. The first transformation occurs at about 5.0 +- 1.0 GPa, the second occurs at about 10.0 +- 1.0 GPa, and the third occurs at about 15.0 +- 1.0 GPa. The structure of the Am phase at 5-GPa pressure is fcc. However, we are unable to determine the structure of the new phases at about 10.0- and 15.0-GPa pressure from our present data. The structural behavior of Am showing that Am undergoes a sequence of structural transformations somewhat similar to the lanthanide metals is discussed.

9422 Surface extended-x-ray-absorption fine structure by means of photon-stimulated ion desorption: O on Mo(100). Jaeger, R.; Feldhaus, J.; Haase, J.; Stoehr, J.; Hussain, Z.; Menzel, D.; Norman, D. (Stanford Synchrotron Radiation Laboratory, Stanford University, Stanford, California 94305). *Physical Review Letters (U.S.);* **45**: No. 23, 1870-1873(8 Dec 1980).

The photon-stimulated desorption (PSD) of O^+ ions from the α-oxygen phase on Mo(100) has been monitored through and above the Mo $L_1(2s)$ absorption edge (2866 eV) and is compared to the absorption spectrum of clean Mo(100). The PSD ion yield is shown to reveal the extended-x-ray-absorption fine structure of Mo surface atoms which were bonded to oxygen atoms prior to their desorption. Studies of the present kind provide a new powerful tool for surface structure investigations.

9423 Substrate-dependent C(1s) shape resonance in CO overlayers on Ni(111) and Ni(001). Davis, R.F.; Kevan, S.D.; Rosenblatt, D.H.; Mason, M.G.; Tobin, J.G.; Shirley, D.A. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). W-7405-ENG-48. *Physical Review Letters (U.S.);* **45**: No. 23, 1877-1880(8 Dec 1980).

A large resonance was observed in the C(1s) angle-resolved photoemission cross section of CO overlayers on Ni(111) and Ni(001), with use of synchrotron radiation at the Stanford Synchrotron Radiation Laboratory, while none was observed for O(1s). Energy-, angular-, and polarization-dependence measurements showed that the C(1s) resonance, which is peaked at hv=311 eV, is closely related to the shape resonance predicted for the C(1s) level in isolated CO. However, the surface potential introduces strong substrate-dependent deviations from gas-phase theory.

9424 High-field specific heat of A-15 Mo/sub 0.4/Tc/sub 0.6/. Stewart, G.R.; Giorgi, A.L. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico). *Journal of Low Temperature Physics (U.S.);* **41**: No. 1, 73-78(1 Oct 1980).

The specific heat of A-15 Mo/sub 0.4/Tc/sub 0.6/ has been measured in a 7-T magnetic field in order to suppress the superconducting transition. With normal state data now available from 7 to 25 K, an improved determination over previous work of γ and $2\Delta/kT$/sub c/ was possible. Thus, more accurate values for γ (6.2 +- 0.5 mJ/g-atom K^2) and $2\Delta/kT$/sub c/ (5.3 +- 0.5) have been determined. These parameters present a more believable picture of the strong coupling behavior of A-15 Mo/sub 0.4/Tc/sub 0.6/ than previously presented. In addition, the low-temperature specific heat data were extended to 1.4 K from the previous work's low of 4 K. These new data enable a determination of θ/sub D/ at T=O (349 +- 5 K) and θ/sub D/ at 7 K (306 +- 5 K) versus the high-temperature θ/sub D/ at T=13 K previously determined (271 +- 3 K).

9425 Non-linear dynamic analysis of piping system using the pseudo force method. Prachuktam, S.; Bezler, P. (Brookhaven National Lab., Upton, NY (USA)); Hartzman, M. (Nuclear Regulatory Commission, Washington, DC (USA)). *International Journal of Pressure Vessels and Piping (England);* **8**: No. 4, 273-282(Jul-Aug 1980).

Simple piping systems are composed of linear elastic elements and can be analysed using conventional linear methods. The introduction of constraint springs, separated from the pipe with clearance gaps, to such systems to cope with the pipe whip or other extreme excitation conditions introduces non-linearities to the system, such non-linearities being associated with the gaps. Since these spring-damper constraints are usually limited in number, discretely located and produce only weak non-linearities, the analysis of linear systems including these non-linearities can be carried out by using modified linear methods. In particular, the application of pseudo force methods, wherein the non-linearities are treated as displacement-dependent forcing functions acting on the linear system, was investigated. The non-linearities induced by the constraints are taken into account as generalised pseudo forces on the right-hand side of the governing dynamic equilibrium equations. Then an existing linear elastic finite element piping code, EPIPE, was modified to permit application of the procedure. This option was inserted such that the analysis could be performed using either the direct integration method or via a modal superposition method, the Newmark-Beta integration procedure being employed in both methods. The modified code was proof tested against several problems taken from the literature or developed with the non-linear dynamics code, OSCIL. The problems included a simple pipe loop, a cantilever beam and a lumped mass system subjected to pulsed and periodic forcing functions. The problems were selected to gauge the overall accuracy of the method and to ensure that it properly predicted the jump phenomena associated with non-linear systems.

9426 High-energy neutron irradiation effects on the tensile properties and microstructure of 316 stainless steel. Vandervoort, R.R.; Raymond, E.L.; Echer, C.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *Radiation Effects (England);* **45**: No. 3-4, 191-198(1980).

Type-316 stainless steel was irradiated at room temperature with 14-MeV, Be(d,n), and fission-reactor neutrons. High-energy neutron irradiations were carried out at the Rotating Target Neutron Source (RTNS-I) at the Lawrence Livermore Laboratory and the 1.93-m Isochronous Cyclotron at the University of California at Davis. Irradiations with fission -reactor neutrons were carried out in the Lawrence Livermore Pool Type Reactor (LPTR). Tensile properties after irradiation were determined at room temperature, and significant changes in strength and ductility were found. Irradiation at all three neutron sources produced a very high density of defects 1 to 2 nm in diameter. The 14-MeV neutrons created more damage on a fluence basis, but the mechanical property and microstructure data could be correlated well on a damage energy basis. The deformation behaviour was in accord with the dispersed barrier model of radiation hardening.

9427 Hydrides and embrittlement of zircaloy-4. Lin, S.C.; Hamasaki, M.; Leo, K.C. (National Tsing Hua Univ., Hsinchu, Taiwan). *Ho Tzu K'o Hsueh (Taiwan);* **16**: No. 1, 1-15(Mar 1979). (In Chinese and English).

This study is a basic research of some mechanical properties of Zircaloy-4 stressed particularly on the influence of hydrogen attack and the hydride orientation and shape effect. The experimental results obtained are as follows: 1) Zircaloy-4 has almost the same tensile properties as those of Zircaloy-2, before and after hydriding. 2) This material may serve well, if hydrogen content is lower than 300 ppM. 3) If we performed spheroidization treatment to the platelet hydrogen in matrix, this material may serve well until 650 ppM hydrogen or more. 4) A discontinuous yielding phenomenon is observed on the specimens tested with the deformation rate of 0.5 cm/min, at room temperature, -196, 100, 200 and 300°C. Above room temperature, this phenomenon is also observed at some other speeds. 5) Beta-phase Zircaloy-4 has an inverse strain rate effect under the deformation at LNT.

9428 Tribological and corrosion behavior of materials for high temperature sodium service. Wilson, W.L.; Galioto, T.A.; Miller, R.L.; Whitlow, G.A. *Microstructural Science (U.S.);* **7**: 265-274(1979). (CONF-780732—).

From Metallographic Society Technical conference; Montreal, Canada (16 Jul 1978).

The behavior of two nickel base alloys, Inconel 718 and Tribaloy 700 under out of reactor conditions is described. Results are presented on the variation of friction coefficients with rubbing distance, sodium temperature (232-627/degree/C), and dwell time in contact; and overall wear coefficients are compared. Corrosion data from sodium loop testing are reported. 6 refs.

3602 Ceramics, Cermets, And Refractories

9429 (ANL-CEN-RSD—80-2) Calculation of the thermodynamic properties of fuel-vapor species from spectroscopic data. Green, D.W. (Argonne National Lab., IL (USA)). Sep 1980. Contract W-31-109-ENG-38. 89p. NTIS, PC A05/MF A01.

Measured spectroscopic data, estimated molecular parameters, and a densty-of-states model for electronic structure have been used to calculate thermodynamic functions for gaseous ThO, ThO_2, UO, UO_2, UO_3, PuO, and PuO_2. Various methods for estimating parameters have been considered and numerically evaluated. The sensitivity of the calculated thermodynamic functions to molecular parameters has been examined quantitatively. New values of the standard enthalpies of formation at 298.15°K have been derived from the best available $\Delta G°$/sub f/ equations and the calculated thermodynamic functions. Estimates of the uncertainties have been made for measured and estimated data as well as for various mathematical and physical approximations. Tables of the thermodynamic functions to 6000°K are recommended for gaseous thorium, uranium, and plutonium oxides.

3603 Composite Materials

9430 (BNL—28714) Cross-linking and catalytic effects of Ca^{2+} ions released from cement on the properties of unsaturated polyester and resorcinol phenol-formaldehyde polymer concrete. Sugama, T.; Kukacka, L.E. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 15p. (CONF-801124—40). NTIS, PC A02/MF A01.

From 3. annual meeting of the Materials Research Society; Boston, MA, USA (17 Nov 1980).

The Ca^{2+} bivalent metallic ions released from the portland cement grains in a polymer concrete (PC) formulation consisting of unsaturated polyester (UP) monomer, water, cement, and aggregate contribute to the prevention of the scission of polymer chains caused by the hydrolysis of the carboxylic ester groups existing in the main chains of UP monomer. This is due to the formation of ionic bonds between the Ca^{2+} ions and the carboxylic anions ($-COO^-$) formed by the hydrolytic reaction of esters. Ca^{2+} ions also have an active catalytic effect on the polymerization rates of PC containing resorcinol phenol-formaldehyde (RPF) as a binder material.

9431 (SAND—80-2780) Plastic analysis of randomly distributed grains in a tensile specimen. Preece, D.S. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 17p. NTIS, PC A02/MF A01.

Results of some preliminary plastic analyses of a composite tensile specimen are presented in this report. The composite was created by randomly assigning one of three different sets of material properties to each finite element. Three different finite element sizes were used in an attempt to discover the influence of mesh fineness on the composite results.

3604 Polymers And Plastics

REFER ALSO TO CITATION(S) 8749, 8749, 9029, 9029, 9029, 9579

3606 Other Materials

REFER ALSO TO CITATION(S) 8742, 8750, 8751, 8754, 8755, 8759, 8760, 8761, 8761, 8768, 8768, 8773, 8774, 8775, 8776, 8777, 8779, 8783, 8795, 8816, 8823, 9175, 9961, 9965

9432 (GA-A—16054) Friction and wear studies of graphite and a carbon-carbon composite in air and in helium. Li, C.C.; Sheehan, J.E. (General Atomic Co., San Diego, CA (USA)). Oct 1980. Contract AT03-76ET35300. 12p. (CONF-810301—2). NTIS, PC A02/MF A01.

From International conference on wear of materials; San Francisco, CA, USA (31 Mar 1981).

Sliding friction and wear tests were conducted on a commercial isotropic graphite and a carbon-carbon composite in air, purified helium, and a helium environment containing controlled amounts of impurities simulating the primary coolant chemistry of a high-temperature gas-cooled reactor (HTGR). The friction and wear characteristics of the materials investigated were stable and were found to be very sensitive to the testing temperature. In general, friction and wear decreased with increasing temperature in the range from ambient to 950°C. This temperature dependence is concluded to be due to chemisorption of impurities to form lubricating films and oxidation at higher temperatures, which reduce friction and wear. Graphite and carbon-carbon composites are concluded to be favorable candidate materials for high-temperature sliding service in helium-cooled reactors.

9433 (UCRL—52963) Optical and electron transport properties of reactively sputtered Cu/sub x/S. Leong, J.Y.C. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 30 Jun 1980. Contract W-7405-ENG-48. 197p. NTIS, PC A09/MF A01.

Thesis.

Thin films of Cu/sub x/S were deposited on glass slides by sputtering Cu in a reactive H_2S/Ar environment. Optical transmittance and reflectance measurements were used to explore the infrared absorption spectra of the material. Analysis of the absorption edge characteristics resulted in the identification of an indirect bandgap at 1.15 (+-.05) eV, a direct bandgap at 1.30 (+-.05) eV, and an electron effective mass of 1.0 (+-0.2) m_0. Electrical data consisting of resistivity and Hall effect measurements from liquid nitrogen to room temperature were analyzed to determine the dominant scattering mechanisms limiting the hole mobility in the material. Ionized impurity scattering was the dominant mechanism at low temperatures ($T < 100°K$) and polar optical phonon scattering was most effective at high temperatures ($T > 150°K$). All films were p-type. Effects of sputtering gas pressure, heat treatments, and temperature on the properties were studied.

9434 EPR spectroscopic characterization of Gd^{3+} in the monazite-type rare-earth orthophosphates: $LaPO_4$, $CePO_4$, $PrPO_4$, $NdPO_4$, $SmPO_4$, and $EuPO_4$. Rappaz, M.; Abraham, M.M.; Ramey, J.O.; Boatner, L.A. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Physical Review [Section] B: Condensed Matter (U.S.);* **23**: No. 3, 1012-1030(1 Feb 1981).

The mineral monazite, a mixed lanthanide orthophosphate $LnPO_4$, is considered as a perfect host for geologic disposal of actinides, rare earths, and possibly other elements formed during nuclear-reactor operation. Synthetic monazite-type orthophosphates of all the elements of the first half of the lanthanide series (except Pm) have been prepared: single crystals were grown using a flux technique, and powders were precipitated in molten urea. The electron paramagnetic resonance (EPR) spectra of intentionally added Gd impurities show that the Gd^{3+} ions occupy predominantly substitutional rare-earth sites in both the flux-grown single crystals and the precipitated powders. Though these sites have a very low (triclinic C_1) symmetry, the spectra were successfully interpreted using an orthorhombic spin Hamiltonian. It has been found that, while the main spin-Hamiltonian parameter b^0_2 is almost constant when going

from the $LaPO_4$ to the $EuPO_4$ host ($b^0_2 \cong +830 \times 10^{-4}$ cm^{-1}), the parameter b^3_2 decreases monotonically from $+373 \times 10^{-4}$ to $+283 \times 10^{-4}$ cm^{-1}, respectively. The complete analysis (i.e., angular variations of the EPR lines and position of the principal electric-field axes relative to the crystallographic axes) of the EPR single-crystal spectra has been done for the two diamagnetic hosts $LaPO_4$ and $EuPO_4$, where the observed EPR lines are the sharpest. It is shown, in particular, that the two magnetically inequivalent EPR spectra (i.e., 14 lines) observed for the monazite-type single crystals are in fact equivalent when the magnetic field is applied parallel or perpendicular to the b axis of the monoclinic structure (i.e., for these directions, only seven degenerate lines are observed). These results are in perfect agreement with the description of the monazite structure whose unit cell contains four "different" rare-earth sites that transform with the symmetry operations of the C/sub 2h/ group.

9435 Neutron diffraction from small numbers of Langmuir-Blodgett monolayers of manganese stearate. Nicklow, R.M.; Pomerantz, M.; Segmueller, A. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review [Section] B: Condensed Matter (U.S.);* **23**: No. 3, 1081-1087(1 Feb 1981).

We report the observation of neutron diffraction from as few as three monolayers of manganese stearate on a plate of about 4-cm^2 area. These room-temperature (paramagnetic state) measurements could be adequately calculated on a laminar model of the crystal structure. Similar calculations, extended to a hypothetical magnetically ordered structure, indicate that the interlayer magnetic structure would be observable already with three layers of magnetic unit cells.

9436 Spectrum and energy levels of Pr^{3+} in $ThBr_4$. Conway, J.G.; Krupa, J.C.; Delamoye, P.; Genet, M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 849-852(15 Jan 1981).

The strong features in the absorption spectrum and the laser excited fluorescence spectrum have been interpreted as arising from levels of Pr^{3+} in the D/sub 2d/ symmetry site of $ThBr_4$. 43 energy levels have been fitted to the parameters with an rms deviation of 61 cm^{-1}. The values of the crystal field parameters are $B^2_0 = 260.0$, $B^4_0 = -644.2$, $B^4_4 = 929.2$, $B^6_0 = 1089.0$, and $B^6_4 = 240.6$ cm^{-1}. The presence of other crystal symmetry sites is observed.

9437 NMR study of compressed supercritical water. Lamb, W.J.; Jonas, J. (Department of Chemistry, School of Chemical Sciences and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 913-921(15 Jan 1981).

The proton spin—lattice relaxation time T_1 in water has been measured as a function of pressure in the temperature range 150 to 700°C. This study focuses on the supercritical region (t/sub c/=374°C) where the spin—rotation interaction mechanism dominates the observed proton relaxation rate. Since water is an asymmetric top molecule, the analysis of the experimental data involves a number of simplifying assumptions discussed in detail. The experimental finding that in supercritical water the spin—rotation relaxation time T_1/sup SR/ is a linear function of density rho, up to relatively high densities (rho≅ 1.5 rho/sub c/) provides rationale for analysis of the NMR experimental data in terms of a model used for dilute gases. The T_1/sup SR/ data are analyzed on the basis of the assumption that the collision modulated spin—rotation interactions can be described by a single correlation function which is an exponential function of time. Using this procedure, we find that T_1/sup SR//rho αT^{-2}, i.e.T_1/sup SR//rho exhibits a stronger temperature dependence than that found (T_1/sup SR//rho αT/sup -3/2/) for many polar and nonpolar gases. The calculated effective cross sections for the transfer of angular momentum σ/sub eff/ which show strong temperature dependence (σ/sub effts/αT/sup -1.5/) are several times larger than the kinetic cross sections. By assuming applicability of expressions derived for isotropic reorientation of spherical-top molecules and using the effective spin—rotation interaction constant as obtained from microwave measurements, we are able to calculate the angular momentum correlation time tau/sub J/, over the range of temperatures and densities studied. In the supercritical region tau/sub J/> or =tau/sub Theta/, where tau/sub Theta/ is the reorientational correlation time, and the estimated mean angle of reorientation Delta-barTheta-bar is in the range 50° to 800°.

9438 Infrared spectrum of ammonia hydrate: Explanation for a reported ammonia phase. Sill, G.; Fink, U.; Ferraro, J.R. (Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona 85721). *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 997-1000(15 Jan 1981).

A number of anomalous spectra of solid NH_3 deposited from the vapor phase have appeared in the literature. These spectra have been ascribed to a new phase of NH_3. In the experiment reported here these anomalous spectra were reproduced by depositing a thin film from a mixture of gaseous NH_3 and H_2O and annealing this film at a temperature of 162 °K. The thin film spectra showed excellent agreement with recent data on NH_3xH_2O. The anomalous "NH_3" spectra are, therefore, seen to be caused by H_2O contamination of solid NH_3 with formation of NH_3 hydrate.

9439 Silicon-29 cross-polarization magic-angle sample spinning spectra in amorphous silicon—hydrogen films. Reimer, J.A.; Murphy, P.D.; Gerstein, B.C.; Knights, J.C. (Division of Chemistry and Chemical Engineering, California Institute of Technology, Pasadena, California 91125). *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 1501-1503(15 Jan 1981).

Magic-angle sample spinning cross-polarization ^{29}Si NMR spectra are reported for plasma-deposited amorphous silicon-hydrogen films. The data show (i) confirmation of the identification of polyhydride (SiH_2)/sub n/ species as seen by infrared spectroscopy and (ii) a large degree of chemical shift dispersion due to disorder in the silicon lattice.

9440 Pressure and temperature dependences of the ionic conductivities of the thallous halidesTlCl, TlBr, and TlI. Samara, G.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review [Section] B: Condensed Matter (U.S.);* **23**: No. 2, 575-586(15 Jan 1981).

Detailed studies of the pressure and temperature dependences of the ionic conductivities of TlCl and TlBr have allowed determination of the lattice volume relaxations and energies associated with the formation and motion of Schottky defects in these crystals. The volume relaxations deduced from the conductivity are found to be comparable in magnitude with values calculated from the strain energy model and a dynamical model. The association energy of Tl^+ vacancies and divalent impurities was also determined for TlBr. A particularly important result is the finding that for these CsCl-type crystals the relaxation of the lattice associated with vacancy formation is outward. Earlier studies on ionic crystals having the NaCl structure have yielded a similar result. This outward relaxation thus appears to be a general result for ionic crystals of both the NaCl and CsCl types (and possibly other ionic lattice types), in disagreement with earlier theoretical calculations which show that the relaxation should be inward for all models of ionic vacancies investigated. The conductivity of TlI was studied in both the (low temperature and pressure) orthorhombic phase as well as in the cubic CsCl-type phase. There is a large electronic contribution to the conductivity in the orthorhombic phase. An interesting result for all three materials is the observation in the cubic phase of a pressure-induced transition from ionic to electronic conduction. This is in qualitative agreement with what is known about the pressure dependences of the electronic structure of these materials.

9441 Doping-precipitated morphology in plasma-deposited a-Si:H. Schiff, E.A.; Persans, P.D.; Fritzsche, H.; Akopyan, V. (Department of Physics and The James Franck Institute, The University of Chicago, Chicago, Illinois 60637). DOE 03-79-ET-23034. *Applied Physics Letters (U.S.);* **38**: No. 2, 92-94(15 Jan 1981).

A grossly inhomogeneous, noncolumnar morphology has been observed in doped, plasma-deposited hydrogenated amorphous silicon (a-Si:H) within critical ranges of the diborane to silane ratio in the gas phase. The diborane level can be as low as 5 ppm and depends both on the electrode self-bias potential and the growth rate. Undoped specimens prepared under the same deposition con-

ditions have properties typical of device-grade a-Si:H. These morphology observations suggest a structural origin for some doping-dependent properties in a-Si:H.

9442 Shear mechanical properties of freely suspended liquid-crystal films in the smectic-A and smectic-B phases. Tarczon, J.C.; Miyano, K. (Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Physical Review Letters (U.S.);* **46**: No. 2, 119-122(12 Jan 1981).

The shear mechanical properties of freely suspended films of liquid crystal, p-butoxybenzylidene-p'-octylaniline (BBOA or 4O.8), have been measured in the smecitc-A and smectic-B phases. All films showed solidlike response well above the bulk A-B transition temperature. Both the in-plane shear modulus and shear dissipation exhibited a very strong frequency dependence in the A and B phases. Films which were two molecules thick showed anomalous behavior at much higher temperatures than thicker films.

9443 Infrared refractive index of silicon. Edwards, D.F.; Ochoa, E. (University of California, Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, New Mexico 87545). *Applied Optics (U.S.);* **19**: No. 24, 4130-4131(15 Dec 1980).

The infrared refractive index of silicon is determined by using the channel spectrum technique.(AIP)

9444 Observation of molecular dissociation of iodine at high pressure by x-ray diffraction. Takemura, K.; Minomura, S.; Shimomura, O.; Fujii, Y. (Institute for Solid State Physics, The University of Tokyo, Roppongi, Minato-ku, Tokyo 106, Japan). DE-AC02-76CH00016. *Physical Review Letters (U.S.);* **45**: No. 23, 1881-1884(8 Dec 1980).

Metallic iodine in the high-pressure phase above P/sub t/ =21 Gpa is found to form a body-centered orthorhombic Bravais lattice. Hence, pressure-induced molecular dissociation takes place at P/sub t/.

9445 Composition dependence of Nd^{3+} homogeneous linewidths in glasses. Pellegrino, J.M.; Yen, W.M.; Weber, M.J. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). W-7405-ENG-48. *Journal of Applied Physics (U.S.);* **51**: No. 12, 6332-6336(Dec 1980).

Optical homogeneous linewidths of the ^{4}F/sub 3/2/—^{4}I/sub 9/2/ transition of Nd^{3+} in oxide and fluoride based glasses are measured foı host composition ranging from simple binary to multicomponent glasses. Homogeneous linewidths at 300 K exhibit a broad range of values, varying by approximately a factor of 4. The ratio of homogenous to inhomogeneous linewidth also varies over a broad range, from 0.16 for a sodium barium borate glass to 1.86 for a rubidium phosphate glass. In addition, the homogeneous linewidth is inversely dependent to the ~2.5 power of the velocity of sound from host to host. This dependence is not predicted by existing theories of the line broadening process.

9446 Further investigation of the 1.4-eV luminescence in solution-grown CdTe:In. Norris, C.B. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *Journal of Applied Physics (U.S.);* **51**: No. 12, 6342-6347(Dec 1980).

Previous attempts to understand the mechanism responsible for the 1.4-eV luminescence in solution-grown CdTe:In were inconclusive because the measured combinations of injection level dependence, frequency response, and temperature dependence did not clearly indicate whether the transition originated from a band state or from a localized level associated with a compact complex. This paper reports the discovery of CdTe:In material in which temperature-dependence data show that the 1.4-eV luminescence transition cannot originate at a band edge. However, the spectrum, injection level dependence, and frequency response of the 1.4-eV luminescence in the present material do not differ greatly from corresponding measurements on previous materials. The new data are presented in detail and include the first extensive measurements of the thermal broadening of the 1.4-eV luminescence.

9447 X-ray compaction of vitreous silica. Primak, W. (Argonne National Lab., IL (USA)). *Radiation Effects (England);* **45**: No. 1-2, 29-32(1979).

Previous measurements in 1962 of the effect of ionizing radiation on the density of pure vitreous silica are compared with the results of a new determination of the effect on a new specimen. The experimental details are given, differences from the previous experiments being noted. The results are discussed.

40 CHEMISTRY

9448 (DOE/ER/10589—1) Chemically modified carbon, nickel and platinum electrodes. Progress report, 15 January-1 October 1980. (Vermont Univ., Burlington (USA)). 1980. Contract AC02-80ER10589. 6p. NTIS, PC A02/MF A01.

Significant progress has been made in three areas: (1) heterobismetallic complexes have been prepared that will be investigated as electrode bound redox catalysts; (2) electrodes capable of catalyzing the reduction of certain alkyl halides have been prepared and are under further investigation; and (3) electrode surface bound viologen polymers have been prepared on carbon and platinum.

4001 Analytical And Separations Chemistry

9449 (AD-A—084826) Gas chromatography-mass spectrometry facility: recent improvements and applications. Technical report. Frew, N.M.; Sawdo, R.M. (Woods Hole Oceanographic Institution, MA (USA). Dept. of Chemistry). Mar 1980. Contracts N00014-66-C-0241;N00014-74-C-0262. 92p. NTIS, PC A05/MF A01.

Marine organic and organic geochemical studies require the best available performance in trace analysis of organic compounds in environmental samples. This report briefly outlines some of the recent improvements in the experimental capabilities of the Chemistry Department Gas Chromatography/Mass Spectrometry Facility (GC/MS Facility) from a user-oriented and non-technical viewpoint. These improvements include principally the interfacing of high performance glass capillary columns with Finnigan 1015 and 3200 quadrupole mass spectrometers, and the adaptation of the latter for use with selective chemical ionization (CI) techniques. Some of the new capabilities available using combined glass capillary GC/EI-MS and CI-MS are illustrated with examples from research in several areas of marine organic chemistry. These include studies of volatile organics in seawater, the distributions of various lipid class compounds in marine phytoplankton, sediments and particulate matter, and the behavior of anthropogenic pollutants in natural and artificial marine ecosystems.

9450 (LA-UR—80-3533) Photoluminescence analysis of NTD-silicon. Hammond, R.B.; Meese, J.M. (Los Alamos Scientific Lab., NM (USA); Missouri Univ., Columbia (USA). Research Reactor Facility). 1980. Contract W-7405-ENG-36. 6p. (CONF-800877—2). NTIS, PC A02/MF A01.

From 3. international conference on NTD-silicon; Copenhagen, Denmark (27 Aug 1980).

First, it is shown that at a fixed temperature of 3.96 K, BE/FE ratios are directly proportional to P concentration in NTD Si. Second, it is also shown that a variation from 0.75 to 30 μs for FE lifetime in our samples did not affect this result. Thus, we have confirmed the major predictions of the theory and established an extremely sensitive and accurate impurity diagnostic for NTD Si. The experimental arrangement gives us a sensitivity to ~ 1 x 10^9 cm^{-3} P. Also, once the experiment is operating, a single sample may be measured and the P concentration calculated in approximately 15 minutes. 1-cm^2 samples about 0.05 cm thick are usually used. The extreme sensitivity of this method suggests its use for very small samples and for impurity profiling of samples.

9451 (LA-UR—80-3623) Methods for deconvolving sparse positive delta function series. Trussell, H.J.; Schwalbe, L.A. (North Carolina State Univ., Raleigh (USA); Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 9p. (CONF-810310—1). NTIS, PC A02/MF A01.

From IEEE international conference on acoustics, speech and signal processing; Atlanta, GA, USA (30 Mar 1981).

Sparse delta function series occur as data in many chemical analyses and seismic methods. These original data are often sufficiently degraded by the recording instrument response that the individual delta function peaks are difficult to distinguish and measure. A method, which has been used to measure these peaks, is to fit a parameterized model by a nonlinear least-squares fitting algorithm. The deconvolution approaches described have the advantage of not requiring a parameterized point spread function, nor do they expect a fixed number of peaks. Two new methods are presented. The maximum power technique is reviewed. A maximum a posteriori technique is introduced. Results on both simulated and real data by the two methods are presented. The characteristics of the data can determine which method gives superior results. 5 figures.

9452 **(LBL—11762) C-13 NMR identification of urea-formaldehyde resins.** Meyer, B.; Nunlist, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 8p. (CONF-810308—3). NTIS, PC A02/MF A01.

From American Chemical Society symposium on the chemistry of engine combustion deposits; Atlanta, GA, USA (29 Mar 1981).

The work shows that adhesive and foam resins differ significantly in qualitative and quantitative composition, and that the differences in the C-13 NMR spectra can be readily recognized, even by an untrained person. The fingerprints of resins are so characteristic that NMR operators who are not familiar with urea-formaldehyde resin chemistry, can rapidly learn how to distinguish between particleboard or plywood adhesives and foam resins, as well as between different manufacturers and individual batches. Thus, the NMR method lends itself extremely well to quality control.

9453 **Determination of boron and lithium in nuclear materials by secondary ion mass spectrometry.** Christie, W.H.; Eby, R.E.; Warmack, R.J.; Landau, L. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Analytical Chemistry (U.S.);* **53**: No. 1, 13-17(Jan 1981).

Secondary ion mass spectrometry (SIMS) has been used for the rapid, accurate analysis of B and Li in various nuclear materials. The problem of sample charging observed in the analysis of insulator materials has been overcome by distributing the sample as a thin film on a conducting substrate. No sample chemistry is required for isotopic measurements and only sample dissolution is necessary for the application of isotope dilution methods for quantitative analysis. The high sensitivity of SIMS for B and Li makes it possible to analyze sufficiently small radioactive samples so that radiation is reduced to acceptable levels for safe handling. The precision of SIMS isotopic analysis for natural B samples is about 0.5% and is about 1.0% for natural Li samples.

9454 **Analysis of styrene polymers by mass spectrometry with filament-heated evaporation.** Udseth, H.R.; Friedman, L. (Brookhaven National Laboratory, Upton, NY). *Analytical Chemistry (U.S.);* **53**: No. 1, 29-33(Jan 1981).

A mass spectrometric study of moderate-sized polystyrene (nominal mol wt 2100) is reported. The polystyrene was evaporated from a probe filament heated at 1000°C/s under both electron-impact (EI) and chemical-ionization (CI) conditions. Under EI conditions extensive fragmentation and depolymerization were observed but nmers out to n = 11 were detected. Under CI conditions, nmers up to n = 27 were detected, and spectra that approximately reproduced the oligomer distribution were obtained. Temperature measurements and activation energies of evaporation rates for many of the ionic species were also measured.

9455 **Optogalvanic double-resonance spectroscopy: experimental observations.** Engleman, R. Jr.; Keller, R.A. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Optics Letters (U.S.);* **5**: No. 11, 465-466(Nov 1980).

Conjunctive effects are observed when two lasers are used to induce impedance changes in a hollow-cathode discharge and when there is an intermediate energy level common to both induced transitions. These conjunctive effects are useful for determining and confirming spectral assignments and for energy-transfer studies.

9456 **Evaluation of a boron-filtered epithermal neutron irradiation facility.** Gladney, E.S.; Perrin, D.R.; Balagna, J.P.; Warner, C.L. (Los Alamos Scientific Lab., Los Alamos, NM). *Analytical Chemistry (U.S.);* **52**: No. 13, 2128-2132(Nov 1980).

Natural isotopic B is used to fabricate a neutron filter for epithermal activation analysis, which is permanently installed near the reactor core. This system has pneumatic tranfer capability for the study of activation products with short half-lives. The analytical properties of this facility are compared to Cd and Cd + B epithermal activation procedures and demonstrated through the analysis of NBS fly ashes for 33 elements. Detection limits are given and interferences from several sources are discussed. 1 figure, 4 tables.

9457 **Effects of atom density distributions and concentration fluctuations in flame atomic absorption spectrometry.** Ramsey, J.M. (Oak Ridge National Lab., TN). *Analytical Chemistry (U.S.);* **52**: No. 13, 2141-2147(Nov 1980).

The dependence of flame atomic absorption measurements on spatial and temporal experimental parameters is investigated through a theoretical model. The model includes geometrical aspects of the optical system and the spatial distribution of the absorbing atoms. Expressions are developed to describe the absorbance for various versions of the model. Analytical working curves are generated by using these expressions, thus illustrating the significance of the various experimental parameters. The results of this study suggest a new burner design which should yield improved performance over conventional slot-type burners. In addition, the effect of analyte flicker noise on working curve linearity in absorption experiments is investigated. 7 figures.

9458 **Size exclusion chromatographic analysis of refuse-derived fuel for mycotoxins.** Bicking, M.K.; Kniseley, R.N. (Iowa State Univ., Ames). *Analytical Chemistry (U.S.);* **52**: No. 13, 2164-2168(Nov 1980).

A Styragel packing material is characterized in several solvent systems by using a series of test solutes and mycotoxins. Differences in interpretation with other work are discussed. Three different separation modes are generated on one stationary phase. An improved separation of mycotoxins from a compilcated matrix results by simultaneously using size exclusion and liquid-liquid partitioning. 4 figures, 3 tables.

9459 **Absorbance determination by time interval measurements.** Ramsey, J.M.; Whitten, W.B. (Oak Ridge National Lab., TN). *Analytical Chemistry (U.S.);* **52**: No. 13, 2192-2195(Nov 1980).

Absorbance measurements are accomplished by placing the sample inside the cavity of a laser which is impulsively pumped. If the laser contains an appropriate gain medium, there will exist a measurable time delay between pumping and the onset of lasing. It is shown that this time delay is related to the optical losses in the laser cavity. Increased time delays due to an intracavity sample can therefore, be related to the absorbance of the sample. The result of this process is that absorbance is determined by measuring a differential time rather than optical power. Absorbances as small as 10^{-3} are measured with an instrument utilizing this new approach. In the small absorbance regime, the differential delay time is linearly related to the absorbance. 3 figures.

9460 **Separation of ethylbenzene from mixed xylenes by continuous adsorptive processing.** deRosset, A.J.; Neuzil, R.W.; Tajbl, D.G.; Braband, J.M. (UOP Inc., Des Plaines, IL). *Separation Science and Technology (U.S.);* **15**: No. 3, 637-653(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

Separation of ethylbenzene at high purity from its mixtures with xylenes has been accomplished commercially by superfractionation. Because of the low relative volatility (1.05) between ethylbenzene and para-xylene, this operation is difficult and energy-intensive, requiring the use of several hundred fractionation trays at a

reflux/feed ratio of about 18. To improve economics and reduce energy usage, a process has been developed to accomplish this separation by selective adsorption from the liquid phase onto a solid adsorbent. In this operation, ethylbenzene is separated from the mixed xylenes within the adsorbent bed, and the two products are recovered from the adsorbent by displacement with a liquid of different boiling point, referred to as desorbent. Desorbent is recovered from the net products by distillation and is recycled. Results of liquid chromatographic tests used to screen various adsorbents are presented. Adsorbents have been developed that show a higher separation factor than the 1.05 existing in distillation, with ethylbenzene being the least strongly adsorbed component. The process has been demonstrated by operation of a pilot plant in which a simulated moving-bed technique is used to obtain the process characteristics of continuous countercurrent flow of adsorbent and process fluid, without actual movement of solids. Results of these operations are presented. The adsorptive process requires less than half of the energy input required by superfractionation. An economic comparison of the two operations is presented.

9461 Pressurized continuous chromatography. Canon, R.M.; Begovich, J.M.; Sisson, W.G. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Separation Science and Technology (U.S.);* **15**: No. 3, 655-678(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

A pressurized continuous annular chromatograph has been developed for preparative separations. This device utilizes a slowly rotating annular bed of sorbent material, fixed multiple feed points, and fixed withdrawal locations. Most of our investigations have been performed with a 28-cm-diam column, but a larger model is being designed and constructed. The separation of copper, nickel, and cobalt components from a carbonate solution has been studied in detail. This solution simulates the leach liquor from the Caron process for recovering nickel and cobalt from laterite ores. Use of continuous gradient elution has been demonstrated. Recent studies have investigated several separations, including that of zirconium and hafnium (necessary for the production of zirconium for use in nuclear reactors), on a preparative scale. This system, because of its continuous feed and product withdrawal, its adaptability to large-scale operations, and its ability to separate many components, is expected to make chromatography a more competitive process in the industrial sector.

9462 New continuous flow reactor for simultaneous reaction and separation. Cho, B.K.; Carr, R.W.; Aris, R. (Dept. of Chemical Engineering and Materials Science, Minneapolis, MN). Contract EY-76-02-2945. *Separation Science and Technology (U.S.);* **15**: No. 3, 679-696(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

The acid catalysed hydrolysis of methylformate has been investigated in a continuous flow annular reactor packed with activated charcoal, and equipped with a rotating feed injection port. Chromatographic separation of the products, formic acid and methanol, effectively suppressed the reverse reaction, causing conversions to be significantly greater than the thermodynamic equilibrium conversions that would have been obtained in the absence of separation. Comparisons of numerically simulated reactor performance with experimental results showed good agreement, although some differences occurred as experimentation proceeded, most probably due to deactivation of the activated charcoal.

9463 Dynamic response of the fluoride ion-selective electrode. Hawkings, R.C.; Corriveau, L.P.V.; Kushneriuk, S.A.; Wong, P.Y. (Atomic Energy of Canada Ltd., Chalk River, Ontario). *Analytica Chimica Acta (Netherlands);* **102**: 61-83(1978).

The dynamic response of the fluoride-selective electrode is shown to result from four distinct processes: ion diffusion, an undefined reaction, LaF_3 dissolution and a calibration drift. Empirical equations are derived which describe the time-e.m.f. relationship over times of the order of days. Dissolution of LaF_3 is shown to be a minor factor in determining the lower limit for measurement of fluoride concentration. The calibration drift process is the main obstacle. The time to thermodynamic equilibrium when the fluoride concentration is reduced becomes very long. A model is given for the calibration drift process. This model explains many of the anomalies reported in the literature for the behaviour of the fluoride-selective electrode. A much more detailed understanding of the calibration drift process is a prerequisite to general application of the fluoride electrode to the measurement of very low concentrations of fluoride.

4002 Inorganic And Physical Chemistry

REFER ALSO TO CITATION(S) 8703, 8706, 9175, 9297, 9484, 9491

9464 (BNL—28948) Formation and disappearance of superoxide radicals in aqueous solutions. Allen, A.O.; Bielski, B.H.J. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 38p. NTIS, PC A03/MF A01.

A literature review of superoxide radicals in aqueous solutions is presented covering the following: history; methods of formation of aqueous HO_2/HO_2^- by radiolysis and photolysis, electrolysis, mixing nonaqueous solutions into water, chemical reactions, enzymatic generation of O_2^-, and photosensitization; and properties of HO_2/O_2^- in aqueous solution, which cover spontaneous dismutation rates, pk and absorption spectra, catalyzed dismutation, thermodynamics and the so-called Haber-Weiss Reaction.

9465 (DOE/ER/04988—2) Spectroscopic investigations of small molecule interactions on metal oxide surfaces. Progress report, September 1, 1979-October 31, 1980. Solomon, E.I.; McFeeley, F.R. (Massachusetts Inst. of Tech., Cambridge (USA)). 31 Oct 1980. Contract AS02-78ER04988. 11p. NTIS, PC A02/MF A01.

Significant advances were made over the past year in surveying with angle integrated uv photoelectron spectroscopy (UPS) the interactions of general classes of chemically important small molecules with metal oxide surfaces, and in elucidating in detail the geometric and electronic structures of the small molecule-surface complexes observed by angle resolved UPS. Progress can be divided into several areas: (1) a detailed understanding of the unique active site structures associated with the interaction of CO with ZnO utilizing angle integrated and angle resolved photoemission spectroscopy; (2) initiating survey studies into new small molecule systems with emphasis on hydrogen and ethylene; (3) successful construction and testing of a high resoltuion electron energy loss spectrometer (HREELS).

9466 (SAND—80-1363) Reaction rates of atmospheric gases with lithium(silicon) alloy. Searcy, J.Q.; Reinhardt, F.W. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1980. Contract AC04-76DP00789. 45p. NTIS, PC A03/MF A01.

Reaction rates of small pellets of Li(Si) alloy with atmospheric gases were studied as a prerequisite to specifying how this alloy should be handled during the production of thermal batteries. The results indicate that Li(Si) reacts with oxygen and nitrogen at ambient conditions too slowly to be of concern, but it reacts very rapidly with water vapor. Rate expressions and constants are developed that allow calculating the weight gain of Li(Si) after its reaction with water vapor, and calculated values are given for three water-vapor concentrations that typify those used in dry rooms where thermal batteries are produced.

9467 Variational transition state theory and vibrationally adiabatic transmission coefficients for kinetic isotope effects in the Cl—H—H reaction system. Garrett, B.C.; Truhlar, D.G.; Magnuson, A.W. (Chemical Dynamics Laboratory, Kolthoff and Smith Halls, Department of Chemistry, University of Minnesota, Minneapolis, Minnesota 55455). *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 1029-1043(15 Jan 1981).

Variational transition state theory and semiclassical adiabatic ground-state transmission coefficients are applied to calculate the kinetic isotope effects for D and T substitution in the reaction $Cl + H_2$ at 245—445 K. The calculated isotope effects differ signifi-

cantly from those calculated previously using conventional transition state theory and semiempirical potential energy surfaces. We use variational transition state theory and conventional transition state theory with the Wigner tunneling correction to adjust three new semiempirical surfaces to the experimental data. No one set of calculations is completely successful. The potential energy surfaces that are most successful at predicting the HD/DH intramolecular kinetic isotope effect have the earliest saddle points (the saddle points are collinear with R/sup double-dagger//sub Clen-dashH/ =2.64—2.78a_0, R/sup double-dagger//sub Hen-dashH/=1.88—1.72a_0). For each surface studied except one, the canonical variational transition states are located past the saddle point for some of the isotopic reactions and earlier than the saddle point for others. The exceptional surface is the one of Valencich and co-workers; that surface has an early saddle point, but the variational transition states are always earlier than the saddle point.

9468 **Monte Carlo sampling techniques and the evaluation of unimolecular rate constants.** Doll, J.D. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 1074-1077(15 Jan 1981).

We discuss the evaluation of unimolecular dissociation constants using Monte Carlo sampling methods. Numerical applications are presented for four atom argon clusters. The energy-dependent rate constants produced by the present procedure agree well with those produced by the dynamical studies of Brady et al. [J. Chem. Phys. 71, 2467 (1979)]. The procedures outlined here are applicable to the problem of evaluating RRKM dissociation rate constants for general interaction potentials.

9469 **Stochastic approach to the theory of intramicellar kinetics. II. Master equation for reversible reactions.** Hatlee, M.D.; Kozak, J.J. (Department of Chemistry and Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 1098-1109(15 Jan 1981).

In this paper we focus on a particular class of intramicellar kinetic processes: reversible reactions of molecularity two taking place in the interior (or perhaps the immediate vicinity) of a micellar assembly. We formulate a stochastic master equation to describe an ensemble of compartmentalized, distributed systems wherein the (only) microscopic chemical event is a photoinduced, reversible, bimolecular reaction. Then, for an initial distribution of reactants assumed to be Poissonian, we calculate and characterize the overall (macroscopic) dynamics displayed by such a system. The resulting kinetic description is compared with the behavior found previously for the simpler case of irreversible, intramicellar kinetic processes. Finally, we introduce and then investigate the notion of an "apparent" equilibrium constant Q for a reversible reaction taking place in a compartmentalized, distributed system and compare this quantity with the "canonical" equilibrium constant K obtained for the (same) reversible reaction carried out in bulk, homogeneous solution. The full behavior of Q=Q(K) is explored numerically, and we prove analytically that $Q \sim K^2$ in the small K limit and that Q is independent of K in the limit of large K. The experimental consequences of the theory are dicussed in some detail.

9470 **Study of the high Rydberg state and ion—molecule reactions of carbon disulfide using the molecular beam photoionization method.** Ono, Y.; Linn, S.H.; Prest, H.F.; Gress, M.E.; Ng, C.Y. (Ames Laboratory, U. S. Department of Energy, and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 1125-1132(15 Jan 1981).

The internal energy effects and the energetics of the ion/molecule reaction of carbon disulfide $CS^+_2xxxCS_2 \rightarrow CS^+_3+CS$, S^+_2+2CS, $C_2S^+_3+S$, and CS^+_4+C have been investigated in detail by photoionization of the neutral van der Waals carbon disulfide dimer. Using the relative Franck—Condon factors obtained by photoelectron spectroscopy, the relative reaction probabilities for the formation of various product channels of the above reactions with CS_2^+ in the B $^2\Sigma$/sub u/$^+$ and C $^2\Sigma$/sub g/$^+$ states were derived from the analysis of the photoionization efficiency (PIE) data for CS^+_3, S^+_2, $C_2S^+_3$, and CS^+_4. From the measured threshold energies for CS^+_3, $C_2S^+_3$, and CS^+_4, the heat of formation at 0 K for CS^+_3, $C_2S^+_3$, and CS^+_4 are deduced to be 291.7 +- 1.7, 318 +- 3, and 246 +- 6 kcal/mol, respectively. By comparing the peak heights of the autoionization resonances in the PIE curves for CS^+_3, S^+_2, and $C_2S^+_3$, and normalizing these to the known absorption cross sections of the corresponding Rydberg levels for CS_2, the relative reaction probabilities for the formation of various product channels of the chemi-ionization processes $CS(_2(V,n)xxxCS_2 \rightarrow CS^+_3+CS+e$, $C_2S^+_3+S+e$, $S^+_2+2CS+e$, and $(CS_2)^+_2+e$ as a function of Rydberg level (n) were determined. The branching ratios of these product channels for the reactions of $CS(_2(V, n=4$ or 5) with CS_2 were also measured. This experiment has demonstrated that molecular beam photoionization studies of van der Waals dimers is an excellent method for the quantitative study of the chemistry of excited molecules, especially for molecules in short-lived radiative states.

9471 **Pulsed laser stimulated field desorption of hydrogen from molybdenum.** Kellogg, G.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 1479-1487(15 Jan 1981).

The recently developed pulsed laser atom probe has been used to investigate the adsorption and dissociation of molecular hydrogen in high electric fields. The results indicate that at temperatures of 60 K and fields of 2.0 V/A and higher, hydrogen is field adsorbed on molybdenum surfaces in molecular form. The activation energy of desorption is found to depend on the square of the applied electric field, in agreement with an expression previously derived for noble gas atoms. The desorption mechanism is shown to be a two-step process consisting of thermal release followed by field ionization and/or dissociation above the surface at x/sub c/ (the critical distance of field ionization). Values of x/sub c/ are obtained for H^+, H_2^+, and He^+, and it is shown that the probability of molecular dissociation at a given field strength can be predicted from simple energetic considerations. An expression relating the number of field adsorbed molecules on a surface with N adsorption sites to various experimental parameters is derived from an empirical rate equation, and data from the present study are shown to be in good agreement with the theoretical predictions.

9472 **Surface structure determinations with ion beams.** Winograd, N.; Garrison, B.J. (Pennsylvania State Univ., University Park). *Accounts of Chemical Research (U.S.);* **13**: No. 11, 406-412(Nov 1980).

Results of some studies concerning atomic descriptions of surface chemical bonds are reviewed. Particular attention is given to investigations of surface structure using ion beams of sufficient energy to induce nuclear rearrangement which is controlled by the original configuration of the atoms. Detection of particles leaving the surface due to the acquisition of a component of momentum sufficient to overcome surface binding forces is carried out with a mass spectrometer, i.e., as in secondary ion mass spectrometry (SIMS). Two major problems related to SIMS that must be solved are: (1) of the ion yields resulting from interaction of primary ion beam with the sample and (2) the lack of an atomistic description of the ion bombardment process. The combination of ion bombardments on well-defined single crystals and results of theoretical classical dynamics calculations is projected to be an excellent complement to low-energy electron diffraction for the future. (BLM)

9473 **Effect of water on flocculation of carbon black in nonaqueous surfactant solutions.** Kitahara, A.; Tamura, T.; Kon-no, K. (Science Univ. of Tokyo, Japan). *Separation Science and Technology (U.S.);* **15**: No. 3, 249-261(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

The effect of solubilized water on stability or flocculation of four kinds of carbon blacks dispersed in cyclohexane solutions of anionic (AOT) or nonionic (NP-8) surfactants was studied. The stable region (A) appeared at the lower concentration range of water. The stability decreased with increasing concentration of water. An additional increase of water concentration caused marked flocculation (region B) followed by the apparent stable dispersion (region C). The stability of the region A and the transient region to B was elucidated by the interaction of the electric double

layers for AOT systems. The flocculation at B may be due to increase of interfacial tension because of the water layer formed on carbon-black particles. The apparent stability of the region C is considered to result from the network structure formed among carbon particles and water-in-oil microemulsion particles for AOT systems. This was suggested from shear rate-stress curves. The appearance of the region C for NP-8 systems is considered to be caused by the viscosity (lamellar structure) of the solution.

9474 **Hydrogen isotope separation by catalyzed exchange between hydrogen and liquid water.** Butler, J.P. (Atomic Energy of Canada, Ltd., Chalk River, Ontario). *Separation Science and Technology (U.S.);* **15**: No. 3, 371-396(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

The discovery, at Chalk River Nuclear Laboratories, of a simple method of wetproofing platinum catalysts so that they retain their activity in liquid water stimulated a concentrated research program for the development of catalysts for the hydrogen-water isotopic exchange reaction. This paper reviews 10 years of study which have resulted in the development of highly active platinum catalysts which remain effective in water for periods greater than a year. The most efficient way to use these catalysts for the separation of hydrogen isotopes is in a trickle bed reactor which effects a continuous separation. The catalyst is packed in a column with hydrogen and water flowing countercurrently through the bed. The overall isotope transfer rate measured for the exchange reaction is influenced by various parameters, such as hydrogen and water flow rates, temperature, hydrogen pressure, and platinum metal loading. The effect of these parameters as well as the improved performance obtained by diluting the hydrophobic catalyst with inert hydrophilic packing are discussed. The hydrophobic catalysts can be effectively used in a variety of applications of particular interest in the nuclear industry. A Combined Electrolysis Catalytic Exchange - Heavy Water Process (CECE-HWP) is being developed at Chalk River with the ultimate aim of producing parasitic heavy water from electrolytic hydrogen streams. Other more immediate applications include the final enrichment of heavy water and the extraction of tritium from light and heavy water. Pilot plant studies on these latter processes are currently in progress.

9475 **Hydrogen isotope separation by bipolar electrolysis with countercurrent electrolyte flow.** Ramey, D.W.; Petek, M.; Taylor, R.D.; Fisher, P.W.; Kobisk, E.H.; Ramey, J.; Sampson, C.A. (Oak Ridge National Lab., TN). *Separation Science and Technology (U.S.);* **15**: No. 3, 405-421(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

Separation of hydrogen isotopes has been successfully demonstrated using bipolar electrolysis combined with electrolyte flow countercurrent to the transport of hydrogen isotope species. Use of multibipolar electrode cells in a squared off cascade is shown theoretically to be capable of efficient tritium separation. Experimental operation of multibipolar cells and analysis of their operation by McCabe-Thiele techniques is described. Palladium-25% silver alloy was found to be suitable as a material for bipolar electrodes permitting high hydrogen throughput with chemical and mechanical stability. Bipolar separation factors, at high current density, using NaOH (NaOD) as the electrolyte, are large (α/sub DT/ = 2.0, α/ sub HT/ = 11 at 90°C). Calculated mass transfer, as determined using a squared-off cascade model, together with observed electrical power consumption suggest that about 21 percent less power will be required for bipolar electrolytic separation as compared with normal electrolysis. This estimate only represents the present level of development. Separation of tritium from light and heavy water using the bipolar electrolysis process appears to offer significant advantages as compared with direct electrolysis. The simplicity and efficiency of the multibipolar cell offer great potential for designing a very compact separation facility which, in turn, will minimize containment cost when high tritium concentrations are encountered.

9476 **Studies of the separation of hydrogen isotopes by a pressure swing adsorption process.** Wong, Y.W.; Hill, F.B.; Chan, Y.N.I. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *Separation Science and Technology (U.S.);* **15**: No. 3, 423-455(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

A theoretical and experimental study was made of the mechanism of the separation of a mixture of hydrogen isotopes by a two-column pressure swing adsorption process in which vanadium hydride was used as the solid phase. Theoretical predictions of process performance were compared with data from process experiments using hydrogen containing a trace of HT as feed. For process operation wholly within the monohydride phase, a postulated isotope effect in the rates of hydrogen adsorption and desorption appeared to control process performance. When process operation involved transitions back and forth between the monohydride and dihydride phases, process performance was determined mainly by an equilibrium isotope effect.

9477 **Carbon isotope separation by absorptive distillation.** Mills, T.R. (Los Alamos Scientific Lab., NM). *Separation Science and Technology (U.S.);* **15**: No. 3, 475-490(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

The feasibility of separating carbon isotopes by absorptive distillation has been studied for CO absorption by cryogenic solvents. Phase equilibrium, isotopic separation, and mass transfer data were taken between 77.4 and 114.3 K for the following solvents: propane, propylene, 1:1 propane-propylene, 1-butene, isobutane and nitrogen. Carbon monoxide solubility followed Henry's Law, with a maximum experimental solubility of 6.5 mole per cent. Isotopic separation between CO in the gas and liquid phases using hydrocarbon solvents was several times that for pure CO vapor-liquid equilibrium. The maximum observed isotopic separation factor was 1.029 at 77.4 K with the propane-propylene solvent mixture. Mass transfer measurements yielded calculated HTU's of 2 to 5 cm for a possible separation system. An attempt has been made to correlate isotopic separation data using Hildebrand's theory of solutions. The differential absorption of isotopic CO species is expressed as a difference in solubility of the isotopic CO molecules. Data for propane, propylene, and 1-butene show approximately the same behavior at varying temperatures.

9478 **Isotope separation by distillation: design of a carbon-13 plant.** McInteer, B.B. (Los Alamos Scientific Lab., NM). *Separation Science and Technology (U.S.);* **15**: No. 3, 491-508(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

This isotope separating plant has a great height with many long columns in parallel, low process flows compared with its boil-up, and a long time response. All these features result from dealing with a mixture whose separation factor is near unity, the carbon monoxide system. Considering that there are three isotopes of oxygen involved, six molecular species are being separated. Although CO molecules are unreacting within the columns, an exchange reactor is used when the separation is partially complete to assist in obtaining high quality product. These considerations have been formulated in a good theoretical design procedure along with excellent mechanical design, fabrication and assembly to yield a plant of high performance for carbon-13 production.

9479 **Application of displacement chromatography to isotope separation.** Jacques, R. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). *Separation Science and Technology (U.S.);* **15**: No. 3, 533-556(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

It is shown that a chromatographic column, operating according to the band-displacement principle, with internal reflux at each end, may be compared to a countercurrent separation column. Simple formulas relate the three parameters which determine the separative performances of the column to the physicochemical characteristics of the process. The parameters are the separation co-

efficient, the height equivalent to a theoretical plate (HETP), and the theoretical flow. The determination of the HETP can be accomplished by either the method of frontal analysis or the method of isotope remixing, by comparing the evolution of the isotope concentration predicted by an appropriate mathematical model and that observed experimentally. The first method concerns a semi-infinite band, limited by a front situated either at the leading or trailing edge of the band and the enrichment directed toward either the solid or liquid phase. Therefore, there are four possible cases. In the second method, the isotope concentration at the top of the column is changed suddenly and the response at the exit-end is observed. For each above-mentioned case, the theoretical formulation of the model, the necessary calculations in a form suitable for solution with a desk computer, the operating mode for treating the experimental results, and some examples are presented.

9480 **Kinetics measurements in liquid-liquid exchange applied to isotopic separation.** Chalabreysse, M.C. (Commissariat Energie Atomique, Pierrelatte, France); Folcher, G. *Separation Science and Technology (U.S.);* **15**: No. 3, 557-566(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

A method using calibrated drops, freely falling through a stationary continuous phase, is commonly used to study the kinetics of heat or mass transfer. This technique has been applied to uranium isotopic transfer between free ions dissolved in an aqueous phase and the corresponding complexes of an organic phase. In this report, results are presented for experiments in which an aqueous hydrochloric acid solution of U(IV) of naturally occurring isotope composition and an organophosphorus extractant, diluted in aromatics, containing a U(IV) complex at ^{235}U atom fraction of 0.5% were used to determine isotopic mixing kinetics. The aqueous phase was fed as calibrated drops through the stationary organic phase at a velocity depending on the drop size and the physical characteristics of the contacted phases. The ^{235}U concentration of the effluent stream was determined as a function of the drop residence time. An isotopic transfer coefficient k/sub A/ (cm/sec) was calculated. Its variation was investigated as a function of drop diameter between 0.07 to 0.4 cm. The plot of k/sub A/ vs diameter can be divided in two regions where k/sub A/ is practically constant. In the region of small drops, the activation energy of k/sub A/ was measured. The low value, 6 kcal/mole, indicates diffusional, rather than chemical transfer resistance. In the diffusion control region the isotopic exchange kinetics are controlled by the physical characteristics of the phases. A model developed from this study is shown to be useful in optimizing the operation of the process.

9481 **Estimation of isotope separation power of chromatography.** Kakihana, H. (Vienna International Centre, Austria). *Separation Science and Technology (U.S.);* **15**: No. 3, 567-585(Apr 1980). (CONF-7910108—).

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

A mathematical model for the distribution of isotopic concentration in a displacement chromatogram is derived starting from a simple concept that the chromatographic movement of species can be expressed as the sum of the movement caused by the external forces and the movement caused by the internal concentration gradient. The theoretical equation is combined with appropriate material balance to develop a set of equations which relate the size, production, and start-up time of the chromatographic separation equipment to the degree of isotope enrichment. These equations are easy to use and require a minimum of empirical data. The model incorporates a series of simplifying assumptions which are valid for displacement chromatography where the isotopic separation coefficient is small and the degree of enrichment accomplished in a single column is not very high. The model is applied to estimate isotope separation power for the cases of boron and uranium isotope separation.

9482 **High precision metal stable isotope ratio measurements using volatile metal chelates.** Hachey, D.L.; Johnston, J.; Klein, P.D. (Argonne National Lab., IL). pp 157-164 of Stable isotopes: proceedings of the third international conference. Klein, E.R.; Klein, P.D. (eds.). New York, NY; Academic Press (1979).

A series of volatile metal chelates was prepared from magnesium, calcium, iron, and cadmium. Mass spectra of these chelates were obtained to evaluate their suitability for the measurement of metal stable isotope ratios. Isotope ratios can be measured to an absolute accuracy of +- 0.03 to 0.72%, depending on the element, the ionization technique, and the magnitude of the isotope ratio. The natural abundance can be determined in a single run for as many as eight isotopes of one element with better than +- 0.48% accuracy when corrected for the natural abundance of ^{13}C, ^{2}H, and ^{18}O present in the chelating agent.

4003 Organic Chemistry

9483 **(AD-A—084941) Relationships between radiative properties and mass content of phosphoric acid, HC, petroleum oil, and sulfuric acid military smokes. Technical report.** Pinnick, R.G.; Jennings, S.G. (Army Electronics Research and Development Command, White Sands Missile Range, NM (USA). Atmospheric Sciences Lab.). Apr 1980. 70p. NTIS, PC A04/MF A01.

The tactical effectiveness of military electro-optical devices such as the forward looking infrared or high energy laser (HEL) systems requires a knowledge of the extinction (absorption and scattering) by the intervening atmosphere. In the case of intentionally produced obscurants such as smokes, a quantitative assessment of these effects generally requires knowledge of the size distribution and concentration of the particles. A relation between the radiative properties of smoke particles and their mass content, even if it is an approximate one, would reduce the complexity of this assessment. One would then only need to know the spacial distribution of the mass content of the smoke particles rather than the details of their particle size distributions and number concentrations. In this report, a linear relation, independent of particle size distribution, between aerosol volume extinction coefficient and mass content is derived and applied to several military smokes: solutions of orthophosphoric acid in water, zinc chloride in water (HC smoke), diesel fuel, fog oil, and sulfuric acid smoke. Comparison of the theoretical extinction-mass relation with infrared (IR) transmission measurements of Milham (1976), Milham et al (1977), and Carlon et al (1977) shows good agreement (generally within 30 percent) between theory and measurement for the highly absorbing phosphoric acid and sulfuric acid smokes , but only fair-to-poor agreement (up to factors of 2.5 to 10 differences) for weakly absorbing HC and fog oil smokes.

9484 **(AD-A—085124) A chemiluminescence study of oxides of nitrogen evolved from propellants. Technical report.** Wallace, I.G.; Powell, R.J.; Downes, B.J. (Propellants Explosives and Rocket Motor Establishment, Waltham Abbey (UK)). Sep 1979. 22p. NTIS, PC A02/MF A01.

A chemiluminescence NO(x) analyser has been used to study nitrogen oxides evolution from single-base and double-base propellants as well as from their nitrate ester ingredients. The technique has illustrated the importance of total oxides of nitrogen as a means of determining the rate at which these materials decompose. The potential of the method as a rapid and unambiguous means of assessing factors such as stability and compatibility is shown. The high sensitivity of chemiluminescence has also permitted the examination of the effect of temperature on decomposition rate down to ambient levels. Consequently one is able to identify changes in the decomposition mechanism as one goes from normal storage temperatures to elevated test temperatures.

9485 **(DOE/ER/05006—2) Carbon-13 magnetic resonance of hydrocarbons. Progress report, September 1, 1978-28 February 1981.** Dalling, D.K.; Morin, F. (Department of Energy, Washington, DC (USA). Div. of Chemical Sciences). 1981. Contract AS02-78ER05006. 12p. NTIS, PC A02/MF A01.

Carbon-13 and proton nmr data have been required for the following series of compounds: tetralin and sixteen of its methylated derivatives; eleven methylated tetrahydrophenanthrene which include the parent compound; and 9,10-dihydrophenanthrene and four of its 9,10 methylated isomers. Data for all these compounds are provided and a detailed discussion on their molecular structure from the chemical shift studies is presented. The temperature de-

pendence of the solution chemical shifts of various methylated derivatives of tetralin has also been determined in $CDCL_4$ from 40°C to -65°C.

9486 (DOE/ER/10624—1) Solid surface luminescence analysis. Progress report, June-December 1980. Hurtubise, R.J. (Wyoming Univ., Laramie (USA). Dept. of Chemistry). 1980. Contract AC02-80ER10624. 41p. NTIS, PC A03/MF A01.

The room temperature phosphorescence (RTP) of some nitrogen heterocycles was enhanced by using HBr instead of HCl. A partial explanation for the enhanced RTP was given. Several solid surfaces and experimental conditions were investigated for inducing RTP from phenols and naphthols. Of all the materials investigated, polyacrylic acid-sodium bromide mixtures and NaBr-treated filter paper were very efficient in inducing RTP. A variety of experimental conditions can be used to enhance RTP. Calibration curves were obtained for phenols and naphthols adsorbed on polyacrylic acid-sodium bromide mixtures. RTP reproducibility data and information on the effect of layer thickness on RTP were obtained. Several procedures for adsorbing compounds on solid surfaces were investigated. Initial work on the effect of acid and base on RTP indicated alkaline conditions favor strong RTP for phenols. Several polymers were shown to induce RTP in phenols and naphthols. Work was initiated on the comparison of RTP with low temperature phosphorescence.

4005 Photochemistry

REFER ALSO TO CITATION(S) 9616, 9631

9487 (LA-UR—80-3459) Single photon excimer laser photodissociation of highly vibrationally excited polyatomic molecules. Tiee, J.J.; Wampler, F.B.; Rice, W.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 14p. (CONF-801201—4). NTIS, PC A02/MF A01.

From 3. international conference on lasers and applications; New Orleans, LA, USA (15 Dec 1980).

The ir + uv photodissociation of SF_6 has been performed using CO_2 and ArF lasers. The two-color photolysis significantly enhances the photodissociation process over ArF irradiation alone and is found to preserve the initial isotopic specificity of the ir excitation process.

4006 Radiation Chemistry

9488 (COO—2567-6) Principal processes in the radiolysis of gases with fission recoils and gamma rays. Annual progress report, October 16, 1979-September 15, 1980. Meisels, G.G. (Nebraska Univ., Lincoln (USA). Dept. of Chemistry). Oct 1980. Contract AS02-76ER01567. 23p. NTIS, PC A02/MF A01.

High resolution mass spectrometry and threshold photoelectron-coincident photoion mass spectrometry of propane-2-^{13}C showed that skeletal isomerization in propane ions precedes the fragmentation of that ion to ethylene ion and methane. Methylnitrite ion was exceptional in its fragmentaion near threshold, the products NO^+ and CH_3O^+ are not competitive. Electron range and energy loss for 50 to 500 eV electrons were measured for the rare gases and nitrogen. Isomerization of nitromethane ion to methylnitrite ion appears to be controlled by electronic state correlation. While highly exothermic even at threshold for parent ion formation of nitromethane, dissociation and presumably isomerization to methylnitrite ion occur only from the upper, 2A″ state of nitromethane ion, which correlates approximately with the 2A″ state of methylnitrite ion.

9489 Reaction of CCl_3 radicals with NO_2. Cumming, J.B.; Cooper, R. (Melbourne Univ., Parkville (Australia). Dept. of Chemistry); Mulac, W.A.; Gordon, S. (Argonne National Lab., IL (USA)). *Radiation Physics and Chemistry (England);* **16**: No. 3, 207-211(1980).

The gas phase pulse radiolysis of dilute solutions of CCl_4 in argon has been used as a source of CCl_3 radicals. Their reaction with NO_2 has been studied by following the kinetics of production of CCl_3NO_2 in the reaction $CCl_3 + NO_2 + M \rightarrow CCl_3NO_2 + M$. The third order rate constant with argon as the third body is (1.2 +- .3) x 10^{11} l^2 mol^{-2} s^{-1} at 300°K. CCl_4 was approximately 10 times more efficient than argon as a third body.

9490 High energy chlorine for chlorine substitution involving Walden inversion in gaseous enantiomers. To, K.; Rack, E.P.; Wolf, A.P. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 1499-1500(15 Jan 1981).

The reactions of /sup 34m/Cl- for Cl substitution in gaseous 2(S)-(+)- a and 2(R)-(-)-chloro-1-propanol are reported at various system pressures and in the presence of neon moderator and a radical scavenger. (AIP).

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 8678, 9708, 9709, 9710, 9724

9491 (DOE/ER/01792—96) Research in actinide chemistry. Progress report, March 1, 1980-February 28, 1981. (Florida State Univ., Tallahassee (USA). Dept. of Chemistry). 1981. Contract AS05-76ER01797. 18p. NTIS, PC A02/MF A01.

The primary purpose of this research is to study the behavior of actinide cations in aqueous solution. The interaction of trivalent actinides with a wide variety of both inorganic and organic ligands has been investigated with emphasis on the thermodynamics and kinetics of complexation at tracer concentrations using radiochemical techniques. In order to expand the scope of the experimental techniques, thereby obtaining additional understanding of the fundamental processes involved, non-radioactive experiments with the trivalent lanthanides have been conducted. Visible spectroscopy, nmr ($_1{}^1$H, $_6{}^{13}$C, $_{57}{}^{139}$La) spectroscopy, potentiometry, solvent extraction and calorimetry are examples of techniques for these lanthanide studies which have allowed much more thorough interpretation of the actinide tracer data due to the close chemical similarity of the lanthanide and actinide families of trivalent cations. The following were investigated: nmr shifts of ^{139}La for both halate and chloroacetate complexes; interaction of Pu(VI) with carbonates and bicarbonates; Ca^{+2}, UO_2^{+2}, and Th^{+4} reactions with halate and chloroacetate anions; complexation of the lanthanides by benzoic acid; thermodynamic formation constants for trivalent lanthanide ions with succinic, glutaric, and adipic acids; complexation of benzene polycarboxylates with lanthanides; complexation of lanthanide ions by AMP (adenosine monophosphate), ADP (adenosine diphosphate) and ATP (adenosine triphosphate); interaction of the actinides ions with humic acid; measurements of water and benzoic acid concentrations in several organic solvents by potentiometric and spectral methods; and plutonium and neptunium redox behavior in the presence of organic complexing agents.

9492 (DOE/ER/03898—52) Hot atom reactions involving multivalent and univalent species. Progress report, February 1980-January 1981. Tang, Y.N. (Texas A and M Univ., College Station (USA). Research Foundation). 1981. Contract AS05-76ER03898. 65p. NTIS, PC A04/MF A01.

Major progress was made in the study of recoil ^{31}Si reactions. The most significant discovery is that monomeric $^{31}SiF_2$ adds to two molecules of C_2H_4 to give 1,1-difluorosilacyclopentane as a final product. When radical scavengers were added, the yield of this product was not altered. When 1,3-butadiene was added to the above recoil ^{31}Si system to compete with C_2H_4 for the available $^{31}SiF_2$, a nearly complementary relationship was found between 1,1-difluorosilacyclopent-3-ene-^{31}Si, the butadiene product, and 1,1-difluorosilacyclopentane-^{31}Si. Quantitatively, it was deduced that butadiene is about ten times more reactive than C_2H_4 for the trapping of $^{31}SiF_2$. When Ne was added as a moderator to the 5:1 C_2H_4:butadiene competition system, the two product ratio shifts from 1:2 in favor of butadiene to 10:1 in favor of C_2H_4. This indicates that it is the lower energy $^{31}SiF_2$ species which is captured by C_2H_4, while it is favorable for the more energetic $^{31}SiF_2$ to be captured by butadiene. In the systems reacting recoil ^{31}Si atoms with

C_2H_4 in the presence of PF_3, four unidentified products with yields less than that of 1,1-difluorosilacyclopentane were also observed. Two of them were also formed when either PH_3 or $(CH_3)_3P$ were used as the ^{31}Si precursor. This means that they are likely to be direct ^{31}Si atom reaction products. When recoil ^{31}Si atoms reacted with C_2H_4 in the presence of $(CH_3)_3P$, the main product was identified as $^{31}SiH(CH_3)_2CH = CH_2$. This might mean the formation of dimethylsilene, $^{31}Si(CH_3)_2$, and the addition of it to $CH_2 = CH_2$ to give the product. In addition, catalytic C-F hydrogenolysis of $CH_2 = CHF$, CH_3CH_2F, $CHF = CHF$, $CH_2 = CF_2$, CH_3CHF_2, and CH_3CF_3 were studied at temperatures ranging from 75° to 400°C. The apparent activation energies and the A factors have been evaluated.

9493 Proteins iodinated by the chloramine-T method appear to be degraded at an abnormally rapid rate after endocytosis. Opresko, L.; Wiley, H.S.; Wallace, R.A. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Proceedings of the National Academy of Sciences of the United States of America (U.S.);* 77: No. 3, 1556-1560(Mar 1980).

Proteins labeled with either ^3H by reductive methylation or ^{125}I by the chloramine-T method were incubated with Xenopus laevis oocytes; the incorporation and acid precipitability of the proteins were then studied. The uptake rates of both specifically incorporated (vitellogenin) and nonspecifically incorporated proteins (bovine serum albumin and X. laevis serum proteins lacking albumin) were not influenced by the method of labeling. However, ^{125}I-labeled proteins were apparently degraded at rates far exceeding their ^3H-labeled counterparts, based on the generation of acid-soluble radioactivity. Thus, after a 3-hr incubation, 3 to 5 times more ^{125}I-labeled bovine serum albumin and X. laevis serum proteins lacking albumin were degraded than the corresponding ^3H-labeled proteins (95% compared to 30% and 75% compared to 15%, respectively), whereas after a 24-hr incubation, the degradation of ^{125}I-labeled vitellogenin was 15 times greater than that of [^3H]vitellogenin labeled in vivo (60% compared to 4%). Moreover, examination of the relative amounts of ^3H-compared to ^{125}I-labeled bovine serum albumin deposited into the exogenously derived yolk platelet compartment of the oocyte revealed 7 times more acid-precipitable ^3H-labeled protein, indicating that the observed discrepancies were not due to reincorporation of the ^3H-labeled ligands. Passage of dissolved oocytes previously exposed to ^{125}I-labeled bovine serum albumin (chloramine-T method) over a column of Bio-Gel P-10 revealed some breakdown of bovine serum albumin to intermediate molecular weight components and the presence of a large amount (≃ 90%) of labeled low molecular weight compounds, which analysis showed to be 72% free iodine.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

9494 (DOE/ET/11056—T2) Combustion of a solid particle. Matalon, M. (Polytechnic Inst. of New York, Farmingdale (USA); Northwestern Univ., Evanston, IL (USA)). 1980. Contract AC01-78ET11056. 32p. NTIS, PC A03/MF A01.

We consider the quasi-steady burning of a carbon particle which undergoes gasification at its surface by chemical reactions, followed by a homogeneous reaction in the gas phase. The burning rate M is found as a function of the gas phase Damkoehler number D/sub g/ for the whole range $o < D/sub\ g/ < \infty$. The monotonic M(D/sub g/) curve, obtained for relatively very hot or very cold particles, describes the gradual transition from frozen flow to equilibrium. For moderate particle temperatures the transition is abrupt and the M(D/sub g/) curve is either S-shaped or Z-shaped. In the former the burning is enhanced at ignition while in the latter it is slowed down; this depends on the relative importance of the two competitive surface reactions. At extinction, the reverse is true: burning is slowed down in the case of an S curve and is enhanced in the case of a Z curve.

9495 (DOE/ET/15303—T5) HC quench layer formation in combustion processes. Technical progress report, May-November 1980. Lavoie, G.A. (Ford Motor Co., Dearborn, MI (USA)). Dec 1980. Contract AC04-79ET15303. 15p. NTIS, PC A02/MF A01.

Objective is to understand wall quenching and other processes responsible for surface generated hydrocarbons in combustion under engine-like conditions. The study concerns the effects of turbulence on the evolution of hydrocarbons. The work is divided into three tasks: (1) combustion bomb experiments to measure the effect of turbulence on the chemical species near the cold surface; (2) combustion bomb experiments, using a similar turbulence generating device, to fully characterize the flow and turbulence in the vicinity of the quenching surface; and (3) an analytical study to characterize fluid mechanical scales of interest in the boundary layer and to find an analytical solution to describe the evolution of the layer.

9496 (DOE/NASA/10350—19) Effect of fuel nitrogen and hydrogen content on emissions in hydrocarbon combustion. Bittker, D.A.; Wolfbrandt, G. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1980. Contract AI01-77ET10350. 24p. (NASA-TM—81612; CONF-810309—6). NTIS, PC A02/MF A01.

From ASME gas turbine conference; Houston, TX, USA (9 Mar 1981).

This paper presents the results of an investigation of the effect of operating conditions and fuel properties on emissions for the two-stage combustion of fuels with significant organic nitrogen content. This is a basic research effort in support of DOE's Advanced Power Systems Program, a development program to adapt ground-power gas turbines to use coal derived fuels. The present paper addresses the important question of how the emissions of nitrogen oxides and carbon monoxide are affected by (1) the decreased hydrogen content and (2) the increased organic nitrogen content of these coal derived fuels. Previous CRT experimental work in a two-stage flame tube has shown the effectiveness of rich-lean two stage combustion in reducing fuel nitrogen conversion to nitrogen oxides (NO/sub x/). Previous theoretical work gave preliminary indications that emissions trends from the tube experiment could be predicted by a two-stage, well-stirred reactor combustor model using a detailed chemical mechanism for propane oxidation and NO/sub x/ formation. The present paper reports additional computations and gives comparisons with experimental results for two additional fuels and a wide range of operating conditions. Fuels used in the modeling are pure propane, a propane-toluene mixture and pure toluene. These give hydrogen contents of 18, 11 and 9% by weight, respectively. Fuel-bound nitrogen contents of 0.5 and 1.0% were used. Results are presented for oxides of nitrogen and also carbon monoxide concentrations as a function of primary equivalence ratio, hydrogen content and fuel-bound nitrogen content. Comparisons with experimental results are given to show that the stirred-reactor model can be used to predict many of the NO/sub x/ and carbon monoxide trends observed experimentally for the range of fuel hydrogen and nitrogen contents used in this work.

9497 (AD-A—083364) Assumptions in analizing the self-ignition process of shattered fuel drops in a hot oxidizer. Wolanski, P. Translated from *Archiwum Termodynamiki i Spalania (Poland);* 8: No. 2, 297-301(1977). 13p. NTIS, PC A02/MF A01.

42 ENGINEERING

4201 General Engineering

9498 (DOE/ER/70004—281) Rotation and shape of high altitude reflectors controlled from the ground. Csonka, P.L. (Oregon Univ., Eugene (USA)). 1979. Contract AT06-76ER70004. 16p. NTIS, PC A02/MF A01.

Orbiting radiowave reflectors are described. These reflectors are to be placed in stationary orbits around the earth, with fine position adjustment made with radiation pressure, to be used as passive communications aids. Methods of stabilization and orientation are discussed. (GHT)

9499 (LA-UR—80-3585) Fundamental understanding of matter: an engineering viewpoint. Cullingford, H.S.; Cort, G.E. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 11p. (CONF-801210—16). NTIS, PC A02/MF A01.

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

Portions of document are illegible.

Fundamental understanding of matter is a continuous process that should produce physical data for use by engineers and scientists in their work. Lack of fundamental property data in any engineering endeavor cannot be mitigated by theoretical work that is not confirmed by physical experiments. An engineering viewpoint will be presented to justify the need for understanding of matter. Examples will be given in the energy engineering field to outline the importance of further understanding of material and fluid properties and behavior. Cases will be cited to show the effects of various data bases in energy, mass, and momentum transfer. The status of fundamental data sources will be discussed in terms of data centers, new areas of engineering, and the progress in measurement techniques. Conclusions and recommendations will be outlined to improve the current situation faced by engineers in carrying out their work. 4 figures.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 8674, 8763, 8764, 9130, 9295, 9551, 9948, 10037

9500 (AD-A—082504) Superconductive dc ship drive systems. Doyle, T.J. (Naval Ship Research and Development Center, Annapolis, MD (USA)). Jul 1973. 18p. NTIS, PC A02/MF A01.

Superconductors are materials which exhibit zero electrical resistance at temperatures near absolute zero, supporting current densities in the order of 100,000 amperes per sq cm in the filamentary wire form. When wound into magnets helium cooled superconductors provide the compact, high flux source necessary for small, efficient electric machines. In ship drive applications, the use of high-power density superconductive generators and motors provide great flexibility of arrangement and of operation. These advantages are illustrated in advanced displacement and surface effect ship hulls with size and performance estimates based on NSRDC d-c machine developments. A recently completed acyclic machine, with a unique magnet-shield configuration designed to maximize flux utilization and power density, is described. The 51 cm (20 inch) diameter unit, now under evaluation, is expected to demonstrate more than 5000 hp per cubic meter at propulsion motor speeds. The machine includes a stationary, niobium titanium wire, solenoidal magnet surrounded by a 1010 steel magnetic shield. Rotor and stator copper drum conductors, series connected through liquid metal brushes, operate in the magnet/shield annulus.

9501 (AD-A—082535) Modeling and error analysis of a superconducting gravity gradiometer. Final report. Wang, K.Y. (Stanford Univ., CA (USA). Guidance and Control Lab.). Aug 1979. 268p. NTIS, PC A12/MF A01.

The demand for higher accuracy in inertial navigation systems has pushed the development of more accurate accelerometers and gyroscopes. Inertial navigation systems (INS) can now be built with error stemming mainly from the uncertainty of the vertical along the flight path (Savet, 1970). The deflection of the vertical is produced by mass anomalies on the surface of the earth. The error can be corrected by measuring the gravity gradient and using it in the navigation equations. This possibility has generated intensive interest and research in the field of gravity gradiometry. The lower bound of the resolution of room temperature gravity gradiometers is thermal (Brownian) noise. By lowering the temperature to 4 K, the noise level is smaller by an order of magnitude. A comparatively simple gravity gradiometer can be built using some newly developed superconducting technology.

9502 (AD-A—083499) Theory and design of electrical rotating machinery. Final report, 1 May 1972-31 October 1979. Carr, W.J. Jr. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Apr 1980. Contract N00014-72-C-0432. 50p. NTIS, PC A03/MF A01.

The objective of this program was to contribute toward new and improved rotating machines for Naval applications, with emphasis on superconducting machinery. Work has been performed on the theory of ac losses in multifilament superconductors and experiments were made to check the theory. A list of publications and abstracts of scientific papers published under the contract is given, and a review is given of the theory of losses. A macroscopic theory for superconductivity in multifilament superconductors was developed, and the theory was used to calculate the hysteresis and eddy current losses which occur in the presence of changing magnetic fields. Both the transverse field and the longitudinal field cases were considered, and also the self-field loss of an alternating transport current, along with some examples of the combined loss due to alternating applied field and transport current. The results are useful for the design of superconducting devices, such as superconducting motors and generators. A small amount of additional work was done on studies of novel homo- and heteropolar motors.

9503 (BDX—613-2445) Testing of heat pipes for cooling a 425°C injection mold. Feldman, K.T. Jr.; Marjon, P.L.; Hahn, D.R. (Bendix Corp., Kansas City, MO (USA)). 1980. Contract AC04-76DP00613. 10p. (CONF-800723—25). NTIS, PC A02/MF A01.

From 19. national heat transfer conference; Orlando, FL, USA (27 Jul 1980).

In order to increase the production rate of a mold used by the Bendix Corporation to manufacture plastic parts, a mold cooling system was designed to use air cooled finned heat pipes. The cooling system was designed to cool the mold from 425 to 150°C (800 to 300°F) at a rate of 28°C (50°F) per minute. Candidate heat pipes were built and tested using 1.91 cm OD steel tube with spiral wound, welded, and segmented fins and with Dowtherm A working fluid. The test data indicated that eight vertical heat pipes, each with a measured overall thermal conductance of 2.00 W/°C, when fitted into holes in the mold, could provide the 28°C minute cooling needed.

9504 (LBL—11605) Microstructure and properties of A15 superconductors formed by direct precipitation. Hong, M.; Dietderich, D.R.; Wu, I.W.; Morris, J.W. Jr. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1980. Contract W-7405-ENG-48. 5p. (CONF-800980—35). NTIS, PC A02/MF A01.

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

Superconducting materials were made by quenching supersaturated solutions of V-Ga and Nb-Al, deforming the quenched specimens, and then precipitating the A15 phase by aging at intermediate temperature. The critical current characteristics of the product materials depend both on the inherent properties of the A15 phase, which presumably reflect its composition, and on the details of the precipitation process, which determine the grain size, continuity, and volume fraction of the A15. These features of the precipitation process differ qualitatively between V-Ga and Nb-Al They are described and used to interpret the critical current characteristics.

9505 (ORNL/RSIC—44, pp 95-106) **TRIMARAN: a three dimensional multigroup P1 Monte Carlo code for criticality studies.** Ermumcu, G.; Gonnord, J.; Nimal, J.C. (CEA, Sacley, France). Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

TRIMARAN is developed for safety analysis of nuclear components containing fissionable materials: shipping casks, storage and cooling pools, manufacture and reprocessing plants. It solves the transport equation by Monte Carlo method, in general three dimensional geometry with multigroup P1 approximation. A special representation of cross sections and numbers has been developed in order to reduce considerably the computing cost and allow this

three dimensional code to compete with standard numerical program used in parametric studies.

9506 **(UCID—18822) NIKE3D: an implicit, finite-deformation, finite element code for analyzing the static and dynamic response of three-dimensional solids.** Hallquist, J.O. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1981. Contract W-7405-ENG-48. 56p. NTIS, PC A04/MF A01.

A user's manual is provided for NIKE3D, a fully implicit three-dimensional finite element code for analyzing the large deformation static and dynamic response of inelastic solids. A contact-impact algorithm permits gaps and sliding along material interfaces. By a specialization of this algorithm, such interfaces can be rigidly tied to admit variable zoning without the need of transition regions. Spatial discretization is achieved by the use of 8-node constant pressure solid elements. Bandwidth minimization is optional. Post-processors for NIKE3D include GRAPE for plotting deformed shapes and stress contours and DYNAP for plotting time histories.

9507 **(UCRL—53069) Effects of strain on the superconducting properties of niobium-tin conductors.** Hoard, R.W. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Nov 1980. Contract W-7405-ENG-48. 226p. NTIS, PC A11/MF A01.

Thesis.

Investigations were performed to ascertain additional information on the connection between the cubic to tetragonal martensitic phase transformation and the phenomenon of superconductivity in Nb_3Sn. Of particular interest is the degradation of the critical parameters, such as T/sub c/, H/sub c2/, and J/sub c/, with mechanical straining of the superconductor. These studies yielded information that assisted in the derivation of the critical current-strain scaling laws mentioned above.

9508 **Quantum-noise theory for the resistively shunted Josephson junction.** Koch, R.H.; Van Harlingen, D.J.; Clarke, J. (Department of Physics, University of California, Berkeley, California 94720). W-7405-ENG-48. *Physical Review Letters (U.S.);* **45**: No. 26, 2132-2135(29 Dec 1980).

We show that the low-frequency spectral density of the voltage noise in a current-biased Josephson junction with critical current I/sub o/, shunt resistance R, and small capacitance is $eI_o/sup ts2/R^3/\pi V$ in the limit eV>>k/sub B/T(I/I/sub o/)^2 and I>I/sub o/, where V is the voltage and I is the current. The noise arises from zero-point current fluctuations in the shunt resistor. The rounding of the current-voltage characteristic caused by the quantum fluctuations and the effects of nonzero junction capacitance are calculated.

4203 Lasers

9509 **(AD-A—082613) Investigation of the pulse-to-pulse phase coherence of carbon dioxide lasers. Final report, 15 January 1979-14 January 1980.** Halford, C.E. (Memphis State Univ., TN (USA). Inst. for Engineering Research). Jan 1980. Contract DAAG29-79-C-0018. 27p. NTIS, PC A03/MF A01.

The phase coherence properties of pulsed carbon dioxide lasers are analyzed. Experimental results for a self-pulsing helium neon ring laser are presented and used to calculate the average phase coherence time for that system. Experimental factors are the primary limitations for phase coherence. These factors influence the phase by altering the resonant cavity by mirror motion or by index of refraction changes. The importance of these two factors are assessed for high power TEA lasers using the experimental results of others. A novel technique of active phase correction for correcting the phase of pulsed lasers is presented.

9510 **(AD-A—082665) Cumulative reactant species index for Volumes I-V of the compilation of data relevant to gas lasers. Volume VI. Technical report.** McDaniel, E.W.; Flannery, M.R.; Manson, S.T.; Gallagher, J.W.; Roberts, T.G. (Army Missile Research and Development Command, Redstone Arsenal, AL (USA). High Energy Laser and Research Lab.). Sep 1979. 143p. NTIS, PC A07/MF A01.

This volume contains a cumulative reactant species index for MIRADCOM Technical Report H-78-1. Volumes I and II covered data relevant to rare gas - rare gas and rare gas - monohalide excimer lasers. Volumes III-V covered data relevant to nuclear pumped lasers.

9511 **(AD-A—082937) A study of cryogenic techniques for operating hydrogen masers. Interim report, 1 July 1979-31 January 1980.** Vessot, R.F.C. (Smithsonian Astrophysical Observatory, Cambridge, MA (USA)). Feb 1980. Contract N00014-77-C-0777. 5p. NTIS, PC A02/MF A01.

Cryogenic Techniques are applied to the Atomic Hydrogen Maser Frequency Standard to extend the storage time of the atoms and reduce the thermal noise accompanying the signal and within the resonance linewidth. Oscillation has been achieved below 25K using wall coatings of frozen CF 4. A pair of new masers is under construction so that frequency stability improvement can be measured. Stability at the 10 to the -16th power level in Delta f/f for averaging time intervals of 1,000 seconds is expected at temperatures below 30K.

9512 **(AD-A—082982) Assessment oF Pr3+:KY3f10 as a blue-green laser. Technical report.** Morrison, C.A.; Wortman, D.F.; Leavitt, R.P.; Jenssen, H.P. (Harry Diamond Labs., Washington, DC (USA)). Feb 1980. Contract MIPR-78-MP-80020A020. 28p. NTIS, PC A03/MF A01.

The reported energy levels of praseodymium and europium in the host material KY3F10 have been analyzed. Using the x-ray data, lattice sums have been done, and odd crystal-field parameters have been calculated. Using these results, the transition probabilities for both magnetic and electric dipoles have been calculated for the rare earth ions. Discussions are given of the application of the results to a blue-green laser using praseodymium.

9513 **(AD-A—083222) Plasma chemistry processes in the closed cycle EDL. Final report, 5 July 1978-5 July 1979.** Thoenes, J.; Kurzius, S.C. (Lockheed Missiles and Space Co., Huntsville, AL (USA)). Jul 1979. Contract DAAH40-78-C-0196. 161p. NTIS, PC A08/MF A01.

Theoretical modeling of plasma chemistry effects on the performance of closed cycle, pulsed, electron beam sustained electric discharge lasers is described. The one-dimensional model considers the mutual interaction of the electron beam, the discharge, the plasma and laser radiation. The most important processes are modeled in terms of experimentally controllable parameters which include the post-foil electron beam current density, primary electron energy, applied electric potential, electrode spacing, initial gas composition, temperature and pressure, electron beam and discharge pulse width, and laser cavity characteristics. Results obtained for several laser gas mixtures are described and compared with experimental data. A detailed analysis has been made of test cases for closed cycle devices under development, including the effect on performance of variations in the electric field, the electron beam current, and the gas mixture composition. Electrophilic plasma by-products have been identified, and recommendations have been developed for experimental efforts to verify the predictions.

9514 **(AD-A—083223) EDLAMP user's manual. Technical report.** Thoenes, J. (Lockheed Missiles and Space Co., Huntsville, AL (USA)). Jul 1979. Contract DAAK40-78-C-0196. 37p. NTIS, PC A03/MF A01.

A computer program is described which can be used to analyze plasma chemistry effects on the performance of pulsed, electron-beam sustained, electric discharge lasers operating either in the open cycle or closed cycle mode.

9515 **(AD-A—083230) Novel resonators for high power chemical lasers. Final letter report.** Garcia, H.R.; Palma, G.E.; Angelbeck, A.W.; Quinnell, R.D.; Urquhart, J.B. (United Technologies Research Center, East Hartford, CT (USA)). 1979. Contract N00173-79-C-0410. 68p. NTIS, PC A04/MF A01.

For the equivalent compacted ring resonator, beam injection can help maintain bare resonator power coupling at the unperturbed value. For small misalignments, injection improves bare beam quality, but it does not improve quality degradation due to

astigmatism. For the annular ring resonator, beam injection maintains both bare resonator power coupling and beam quality at the unperturbed values for very small misalignments. And, as expected, this resonator is much more sensitive to misalignment than its equivalent compacted resonator. Additionally, the reverse wave analysis has shown the unstable ring/linear stable MO injection configuration to offer satisfactory reverse wave suppression. Based on bare resonator analyses injection locking shows promise. To determine its potential, loaded resonator analyses for high-power devices must be performed. mode discrimination, possible parasitics, sensitivity to misalignment,and scale-ability to high power are potential problems that need in-depth investigation. Additionally, the technical issues associated with cavity length equalization to less than lambda; matching of the MO and HEL spectra; and the stability, mode matching and power requirements for the MO need to be addressed experimentally so the real hardware requirements can be established.

9516 **(AD-A—083427) Research in laser processes. Semiannual report, 1 February-31 July 1979.** Phelps, A.V.; Gallagher, A.C. (Joint Inst. for Lab. Astrophysics, Boulder, CO (USA)). 15 Apr 1980. Contract N00014-76-C-0123. 50p. NTIS, PC A03/MF A01.

A model has been completed of the NaXe discharges examined experimentally under this contract. This model includes the effects of electron excitation, deexcitation and ionization of excited Na atoms, as well as electron loss processes such as dissociative recombination with Na2(+). By adopting apparently reasonable rate coefficients and reaction end products we are able to satisfactorily reproduce the measured steady-state densities of excited Na atoms. However, a serious and unexplained discrepancy is found in the energy balance for these discharges. By extrapolating these results to high Na densities we find what appears to be a region of sufficient optical gain at 700 nm for laser oscillation. Such a laser would require a short excitation pulse (approx. 100 ns) and would have a low discharge impedance. A new technique has been developed for the measurement of electron excitation rate coefficients for the metastable states of the rare gases. A multipass absorption cell and a single mode dye laser allow measurement of metastable densities as low as 1,000,000 atom/cc.

9517 **(LA-UR—80-3621) Ultraviolet phase conjugation and its practical implications.** Shapiro, S.L.; Fisher, R.A.; Feldman, B.J. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810204—1). NTIS, PC A02/MF A01.

From SPIE symposium on high-power lasers and applications; North Hollywood, CA, USA (11 Feb 1981).

We report the first demonstration of uv phase conjugation. Using a 15 psec, 2660 A pulse, 0.1% conjugate reflectivities were obtained via degenerate four-wave mixing in 1-mm samples of CS_2 mixtures. While pure CS_2 did not exhibit the effect, dilution in several uv transmitting solvents opened up a concentration-tunable (2450 A - 2850 A) spectral window, allowing the optical Kerr effect to be utilized. Weaker phase conjugation at 2660 A was also observed in other Kerr media and in saturable absorber media.

9518 **Electron energy distribution in photolytically pumped lasers.** Morgan, W.L.; Franklin, R.D.; Haas, R.A. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). W-7405-ENG-48. *Applied Physics Letters (U.S.);* **38**: No. 1, 1-3(1 Jan 1981).

Calculations of the electron energy distribution function in mixtures of Se(^{1}S), CO, and Xe are presented. The Se(^{1}S) arises from photolysis of OCSe by Xe_2 vacuum ultraviolet excimer radiation, and the electrons are due to photoionization of the Se(^{1}S). The calculations show that highly non-Maxwellian electron energy distribution can result from electron heating by super-elastic deexcitation of Se(^{1}S) and cooling by inelastic excitation of CO vibrational levels and Xe electronic states. The kinetic rate constants computed using these distributions differ significantly from those derived from a Maxwellian distribution. It is found that the kinetic rate constants are sensitive to variations in the fractional ionization ($\alpha > 10^{-6}$), relative CO concentration (n/sub co//n/sub Se/(^{1}S)> or =1), CO vibrational temperature (T/sub v/ >1000 °K), and fractional Xe metastable density ($n^*/n > 10^{-5}$). Adding the molecular buffer, CO, cools electrons and slows multiplication.

9519 **Multiphonon relaxation rates from delayed laser emission in Nd-YAG crystals.** Ramsey, J.M.; Whitten, W.B. (Analytical Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Applied Physics Letters (U.S.);* **38**: No. 1, 9-11(1 Jan 1981).

Delayed laser emission from a ND-YAG oscillator pumped by a 532-nm 50-ns pulse is interpreted in terms of multiphonon relaxation from the pumped levels to the upper laser level. The relaxation rate constant, (1.6 +- 0.2) x 10^6 s^{-1}, is in good agreement with previous results obtained from the fluorescence rise time.

9520 **Real-time laser damage monitoring with photoacoustics.** Rosencwaig, A.; Bacigalupi, L.S.; Willis, J.B. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). W-7405-ENG-48. *Applied Optics (U.S.);* **19**: No. 24, 4133-4134(15 Dec 1980).

A method for automatic real-time damage monitoring on optical components with dielectric coatings, using piezoelectric photoacoustic detection, is developed.(AIP)

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 9208, 9526

9521 **(SAND—79-1623) MARIAH: a finite element computer program for incompressible porous flow problems.** Gartling, D.K.; Hickox, C.E. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 97p. NTIS, PC A05/MF A01.

MARIAH is a finite element computer program designed for the solution of two-dimensional, incompressible flows in a porous media, including the effects of heat transfer. The program capabilities and complete user instructions are presented. Several example problems are described in detail to demonstrate the use of the program. The theoretical background for MARIAH is documented in the Sandia Laboratories Report, SAND—79-1622.

4205 Materials Testing

9522 **(LBL—10341(Rev.)) Non-destructive failure prediction for brittle solids.** Evans, A.G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 20p. (CONF-801072—4(Rev.)). NTIS, PC A02/MF A01.

From Symposium on irradiation phase stability; Pittsburgh, PA, USA (5 Oct 1980).

Structural design with brittle materials requires that the stress level in the component correspond to a material survival probability that exceeds the minimum survival probability permitted in that application. This can be achieved by developing failure models that fully account for the probability of fracture from defects within the material (including considerations of fracture statistics, fracture mechanics and stress analysis), coupled with nondestructive techniques that determine the size of the large extreme of critical defects. Approaches for obtaining the requisite information are described in this paper.

4208 Electronic Circuits And Devices

9523 **(MLM—2796(OP)) Cermet-bonded metal pins for weldable electrical feedthroughs in alumina.** Kelly, M.D. (Mound Facility, Miamisburg, OH (USA)). 1981. Contract AC04-76DP00053. 13p. (CONF-810108—1). NTIS, PC A02/MF A01.

From 5. annual conference on composites and advanced materials; Cocoa Beach, FL, USA (18 Jan 1981).

In several applications Mo/Al_2O_3 cermets are used for providing electrical feedthroughs in alumina substrates. An engineering technique to insert metal pins through the alumina body, while maintaining the benefits of the cermet, has been developed. In this two-step process, metal tubes (molybdenum) are inserted into holes drilled in a green Mo/Al_2O_3 cermet and sintered in place. Then, copper or Kovar metal pins are diffusion bonded in these tubes. The metal pins form electrical feedthroughs which are more con-

ductive, stronger, and require fewer processing steps than the present methods of using cermet feedthroughs.

9524 **Afterpulses in a photomultiplier tube poisoned with helium.** Bartlett, D.F.; Duncan, A.L.; Elliott, J.R. (Dept. of Physics, University of Colorado, Boulder, Colorado 80309). *Review of Scientific Instruments, The (U.S.);* **52**: No. 2, 265-267(Feb 1981).

A five-inch photomultiplier tube (RCA #4522) was run continuously for eight weeks surrounded by a pure helium atmosphere. Although some evidence of afterpulsing was seen as early as the end of the first week, the fraction of pulses having afterpulses did not reach 15% until after four weeks. The gain of the tube was unaffected by the helium until about the sixth week when suddenly the gain dropped by a factor of 10. The temporal distribution of the afterpulses (600—1200 ns) is readily explained by the voltage distribution between the cathode and the first dynode.

4209 Waste Processing Plants And Equipment

REFER ALSO TO CITATION(S) 9320, 9321, 9728

9525 **(EGG-WM—5271) Design criteria for Reedy Creek Demonstration Project.** Felicione, F.S.; Logan, J.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1980. Contract AC07-76ID01570. 48p. NTIS, PC A03/MF A01.

This document defines the basic criteria for the 100-ton/day pilot plant which will use the Andco-Torrax pyrolysis process at Walt Disney World in Orlando, Florida, to produce hot water. The waste will simulate transuranic wastes which are stored at INEL. The Andco-Torrax process is designed to convert mixed municipal refuse into energy and is called slagging pyrolysis solid waste conversion. (DLC)

4210 Combustion Systems

9526 **(UCRL—84519) Transient boundary-layer flows in combustion environments.** Kang, S.W.; Levatin, J.L. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Nov 1980. Contract W-7405-ENG-48. 7p. (CONF-810106—2). NTIS, PC A02/MF A01.

From 19. Aerospace Sciences meeting; St Louis, MO, USA (12 Jan 1981).

Unsteady boundary-layer flow equations characterizing hot, burning environments are solved numerically by means of a factored ADI method under transient and/or streamwise varying core-flow conditions. Calculated results for compressible, turbulent flow cases show that high heat fluxes at the wall due to turbulence and changing edge conditions may bring about severe temperature increase at the wall, causing melting and hence erosion of the surface itself.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 9243, 9621, 9757

4250 Power Cycles

REFER ALSO TO CITATION(S) 9375

9527 (CONF-800419—(Vol.1), pp 356-368) **Stirling Engine Systems: Stirling engine total energy system: recreational vehicle application.** Lampert, W.B. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The modern Stirling Cycle Engine is one which can meet today's growing demands on power sources for many applications. In addition to meeting this demand, Stirling engines can provide: multi-fuel capability, low maintenance, long life, clean exhaust, low fuel consumption, low noise, low vibration, and rejected heat concentrated on engine coolant. With this unique combination of attributes, the Stirling engine has many potential applications. A Stirling engine powered Total Energy System (TES) is only one example. The application of interest is for a small Total Energy System. Such an application requires a 10 to 20 HP power source which will provide living environment comfort and convenience without the noise, vibration, exhaust odor, high maintenance, or low reliability often associated with alternative power sources. Recreational applications such as recreation vehicles, marine, and remote cottages are examples. The design and performance of such total energy systems and the associated Stirling engine and its components are discussed. (LCL)

9528 (CONF-800419—(Vol.1), pp 369-391) **Stirling Engine Systems: international developments in Stirling engines.** Martini, W.R. Oct 1980.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

The design, operation, performance and uses of Stirling engines are reviewed, and developments around the world in research and production activities related to Stirling engines are discussed. (LCL)

43 PARTICLE ACCELERATORS

4302 Beam Dynamics, Field Calculations, And Ion Optics

9529 **(LA—8668-MS) Calculation of the transfer matrix T in six dimensions for an rf-deflector element.** Bongardt, K. (Los Alamos Scientific Lab., NM (USA)). Jan 1981. Contract W-7405-ENG-36. 26p. NTIS, PC A03/MF A01.

One possible element for funneling two beams together is a deflector with a constant or time-varying electric-field strength. With such an element, arbitrary beams can be brought together and maintained on the axis, if the appropriate combination of deflector parameters is chosen. A parallel beam can be handled only with a time-varying voltage of the deflector. The six-dimensional transfer matrices are calculated for constant or time-varying fields; all the results are correct in first-order approximation.

9530 **(LBL—10753) Kinetic equations for longitudinal stochastic cooling.** Bisognano, J.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract W-7405-ENG-48. 9p. (CONF-800740—26). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

A kinetic equation approach to stochastic cooling is presented. Equations for one and two particle distribution functions are derived from the principle of conservation of the number of ensemble systems. The violation of Liouville's theorem is expressed by certain self-interaction terms. The two-particle distribution describes Schottky noise and feedback effects and is analyzed by techniques of the Lenard-Balescu equation for plasmas. The resulting expression for the one particle distribution is of the form of a Fokker-Planck equation. The suppression of Schottky signals for arbitrary machine impedance is discussed in terms of particle correlations.

9531 **(SLAC-PUB—2624) Proceedings of the beam-beam interaction seminar.** (Stanford Linear Accelerator Center, CA (USA)). Oct 1980. Contract AC03-76SF00515. 342p. (CONF-8005102—). NTIS, PC A15/MF A01.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

The beam-beam interaction has been and continues to be a performance limiting effect in colliding beam systems. Electron-positron collisions are typically more than a factor of five lower in luminosity than expectations from beam design and with present understanding, extrapolations to future systems are not satisfactory. Prediction and optimized design are even more uncertain for proton-proton and proton-antiproton future systems with the ISR at CERN being the sole precedent. The very health of the high energy physics program in the next decades depends to a significant extent on our ability to unravel the mechanisms of this phenomenon and to control them. There have been a variety of studies, including a plasma model of e^+e^- collisions, models emphasizing the effects of noise and a model involving a diffusion-damping equilibri-

um. Various nonlinear analyses of the beam-beam systems have also been performed. And finally an entirely new form of beam-beam configuration has been proposed and studied - the very strong single pass collider. In view of this extensive and broad effort, there was organized an informal seminar to bring many of these ideas into an open forum. This seminar was held at SLAC on May 22 and 23, 1980. Contributors, totaling seventeen, came from universities and national laboratories across the United States. These proceedings represent a record of the seminar. The written versions of the papers presented were submitted by the authors and are included here without editing.

9532 (SLAC-PUB—2624, pp 1-20) **Simulation study of the beam-beam interaction at SPEAR.** Tennyson, J. (Univ. of California, Berkeley). Oct 1980.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

A two dimensional simulation study of the beam-beam interaction at SPEAR indicates that quantum fluctuations affecting the horizontal betatron oscillation play a critical role in the vertical beam blowup.

9533 (SLAC-PUB—2624, pp 21-32) **Beam-beam luminosity limitation in electron-positron colliding rings.** Peggs, S.; Talman, R. (Cornell Univ., Ithaca, NY). Oct 1980.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

To account for observed luminosity limitations in electron-positron colliding rings the leading effects are identified, the nonlinear single particle equation solved exactly, the strong beam-strong beam equilibrium obtained by numerical simulation, the luminosity calculated, and regions of bad beam lifetime identified.

9534 (SLAC-PUB—2624, pp 33-39) **Beam-beam effect and luminosity in SPEAR.** Wiedemann, H. (Stanford Linear Accelerator Center, CA). Oct 1980.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

Measurements performed at SPEAR have been discussed and scaling laws for the maximum luminosity and the maximum linear tune shift parameter with energy are shown. There are two distinct regimes, one below 2 GeV where the linear tune shift parameter scales like $\xi_y \sim E^4$ and the other regime where this parameter is constant ξ_y asymptotically equal to 0.05 to 0.06. In the lower energy regime the limit is reached when the vertical beam size is blown up to the acceptance of the storage ring. A significant (< 10%) horizontal beam blow up is not observed and the value of the horizontal linear tune shift parameter ξ_x does not seem to be related to the beam-beam limit.

9535 (SLAC-PUB—2624, pp 40-69) **Recent experimental results on the beam-beam effects in storage rings and an attempt of their interpretation.** Kheifets, S. (Stanford Linear Accelerator Center, CA). Oct 1980.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

The latest available experimental results on the luminosity, the space charge parameters, and the beam blowup as functions of particle energy and beam current are reviewed. The comparison with the phenomenological diffusion theory are done and useful scaling laws are derived. Some implications for anti pp storage rings are discussed.

9536 (SLAC-PUB—2624, pp 80-98) **Beam-beam studies with DCI.** LeDuff, J. (Lab. de l'Accelerateur Lineaire, Orsay, France). Oct 1980.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

An attempt to compensate for the beam-beam effect was done on DCI but did not succeed in yielding higher performances. The compensation scheme uses four beams stored in two rings having two common straight sections. A residual space charge force appears as a consequence of a non-perfect compensation if the companion beams are not well superposed. The original aim was to keep the residual linear space charge force one order of magnitude below the corresponding usual beam-beam force in order to get ten times more current per beam for collision. This has been set up experimentally by proper adjustment of the two rings and by correcting the relative orbit displacement between the two rings within a fraction of sigma in both common straight sections. As a reference for the four beam studies, preliminary experiments were performed with one ring or another. Strong increase of the transverse cross section is observed which becomes gradually less as the energy is increased. With four beams, up to the limit, there is no appreciable blow up, but the limit in terms of maximum current per beam is much smaller than in the e^+e^- case. Each type of interaction shows discrete stable areas in the operating diagram (ν_x, ν_z) which seem to indicate a strong effect of non-linear resonances of relatively high order. A few experiments were also performed with three beams in a strong-weak configuration but it merely proved that the incoherent beam-beam limit was partially compensated and more work is required before any conclusion can be drawn.

9537 (SLAC-PUB—2624, pp 99-113) **Beam-beam phenomenology.** Teng, L.C. Oct 1980.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

In colliding beam storage rings the beam collision regions are generally so short that the beam-beam interaction can be considered as a series of evenly spaced non-linear kicks superimposed on otherwise stable linear oscillations. Most of the numerical studies on computers were carried out in just this manner. But for some reason this model has not been extensively employed in analytical studies. This is perhaps because all analytical work has so far been done by mathematicians pursuing general transcendental features of non-linear mechanics for whom this specific model of the specific system of colliding beams is too parochial and too repugnantly physical. Be that as it may, this model is of direct interest to accelerator physicists and is amenable to (1) further simplification, (2) physical approximation, and (3) solution by analogy to known phenomena.

9538 (SLAC-PUB—2624, pp 114-143) **Plasma instability in electron and positron colliding beams in storage ring.** Uhm, H.S. (Naval Surface Weapons Center, Silver Spring, MD); Liu, C.S. Oct 1980.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

The filamentation instability of the electron and positron colliding beams in a storage ring are investigated within the framework of the rigid beam model and the Vlasov-Maxwell equations, and closed algebraic dispersion relations for the complex eigenfrequency ω are obtained. It is shown that the typical growth rate of instability is a substantial fraction of the electron plasma frequency ω_{pe}, thereby severely limiting the electron density in a storage ring. Moreover, the influence of collective self-field effects on the electron and positron colliding beams in the storage ring is investigated. The analysis is carried out, distinguishing the cases, where (a) the particle motions are in a very coherent orbit, and (b) the randomness dominates the operational condition of a storage ring (e.g., the incoherent collision location by small fluctuation, etc.) In either case, it is shown that the self-fields effects play a dominant role in the stability behavior of transverse orbit or the expansion of the beam cross section.

9539 (SLAC-PUB—2624, pp 205-234) **Analysis of the beam-beam interaction using transfer maps.** Dragt, A.J.; Jakubowicz, O.G. (Univ. of Maryland, College Park). Oct 1980.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

The method of transfer maps is used to develop generalized Courant-Snyder invariants in the presence of the beam-beam interaction for both nonresonant and resonant tunes. Numerical evidence is presented to illustrate that the generalized invariants are indeed constant through terms of first order in the beam-beam interaction strength. The invariants are next used as a magnifying glass to search for irregularities and evidence of stochastic behavior. It is found that within the model employed, the beam-beam interaction at its contemplated strengths shows no evidence of producing particle loss in ISABELLE.

9540 (SLAC-PUB—2624, pp 248-272) **Role of resonances, stochasticity and Arnol'd diffusion in models of the beam-beam interaction.** Bountis, T.C. (Clarkson Coll., Potsdam, NY). Oct 1980.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

Some recent results on the long time behavior of the orbits of two- and four-dimensional mappings which display, in a qualitative way, most of the complicated features of the Beam-Beam Interaction are reviewed. This behavior depends crucially on the location of the initial conditions of the orbits with respect to the largest (i.e. lowest order in perturbation theory) resonances of the system. In the stochastic regions, where these resonances overlap, the properties of the motion are well described by classical diffusion processes. In 4-dimensional mappings, where Arnol'd diffusion occurs, various theoretical and empirical methods proposed by Chirikov yield estimates of the rates of particle diffusion which are in good agreement with experimental evidence. 22 references, 9 figures.

9541 (SLAC-PUB—2624, pp 273-311) **Preliminary numerical study of the beam-beam interaction in two dimensions.** Eminhizer, C.R. (Physical Dynamics, Inc., La Jolla, CA). Oct 1980.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

A preliminary numerical study of the beam-beam interaction in two dimensions was undertaken to determine the feasibility of an extensive numerical and analytic effort to locate regions of stable motion if they exist. In particular, to find the parameter ranges ($\Delta\nu$, Q, etc.) and the size of the regions in phase space over which the weak beam will be stable. Because of the difficult problem of displaying phase space trajections in a space of more than two dimensions, it is helpful to select a two-dimensional beam shape and charge distribution which reduces these difficulties. The present study deals only with a two-dimensional bunched beam with symmetrical charge distribution. It is shown that a three-dimensional phase space is adequate for the display of its motion (which significantly reduces display problems and the number of parameter values to be tested. Preliminary numerical results indicate that a region of stable motion may exist and that a systematic effort to locate the boundaries and the degree of stability would be useful. It is shown that there are trajectories of the motion of the two-dimensional beam which remain bounded for 100,000 iterations of the mapping, t/sub max/ = 100,000.

9542 (SLAC-PUB—2624, pp 312-331) **Nonlinear Hill's equations and the beam-beam interaction.** Vuillermot, P.A. (Georgia Inst. of Tech., Atlanta). Oct 1980.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

Nonlinear Hill's equations of the form $z''(\theta) + n(\theta)z(\theta) = F(\theta;z)$ frequently occur in the description of betatron oscillations in cyclic accelerators and in intersecting storage rings. In the equation, θ stands for the azimuth around the machine (of radius 1), n denotes a periodic function with (minimal) period $T \leqq 2\pi$, while F generally depends nonlinearly on z and also periodically on θ with, however, a minimal period T' in general different from T. In this paper new results are presented, without detailed proofs, regarding the stability properties of a class of equations of this form, relevant to the problem of the beam-beam interaction in the weak-strong approximation. Specifically, new inequalities for the corresponding action functional, valid in particular whenever the strong beam has an anisotropic (ribbon-like) Gaussian current density are discussed. The variational problem is then solved by direct methods, its connection with the existence problem of periodic orbits is established, and finally, it is briefly indicated how to construct the minimizing sequences involved.

9543 (SLAC-PUB—2624, pp 332-343) **Enhancement of diffusion by a non-linear force.** Neuffer, D.; Ruggiero, A. Oct 1980.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

Several observers have recently speculated that the simultaneous presence of diffusion processes and the beam-beam interaction may lead to enhanced diffusion or beam loss greater than that present with either diffusion or the beam-beam interaction alone. To test these ideas a computer code was written to simulate the effects of random diffusion and the beam-beam interaction. In this paper some first results of these simulations are presented. It is found that when the strength parameter of the beam-beam force $\Delta\nu$ includes a resonance within its tune width enhanced diffusion occurs.

9544 (SLAC-PUB—2624, pp 344-346) **Investigation of the flip-flop beam-beam effect in SPEAR.** Donald, M.H.R. (Lawrence Berkeley Lab., Berkeley, CA); Paterson, J.M. Oct 1980.

From Seminar on the beam-beam interaction; Stanford, CA, USA (22 May 1980).

When colliding electron and positron bunches in SPEAR at high values of the beam-beam tune shift parameter $\Delta\nu$, it had been observed that sometimes one of the equal intensity beams would blow up in the vertical plane more than the other beam. It was subsequently found that a small adjustment to the phase difference between the RF accelerating cavities would make the beam flip the other way. The results of the investigation of this phenomenon are presented in this paper.

9545 **Consequences of Pierce instability for focusing of neutralized ion beams.** Poukey, J.W.; Quintenz, J.P.; Olson, C.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *Applied Physics Letters (U.S.);* **38**: No. 1, 20-22(1 Jan 1981).

The effects of Pierce-type space-charge instabilities in high-energy ion beams, initially neutralized by co-moving electrons, are discussed in terms of planar and two-dimensional spherical geometries. The limiting ion current which can reach a target is given.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 9529

9546 **(BNL—28779) Use of the linear accelerator for incinerating the fission products of ^{137}Cs and ^{90}Sr.** Takahashi, H.; Mizoo, N.; Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). Jul 1980. Contract AC02-76CH00016. 21p. (CONF-800743—14). NTIS, PC A02/MF A01.

From International conference on nuclear waste transmutation; Austin, TX, USA (22 Jul 1980).

Transmutation of fission products ^{137}Cs and ^{90}Sr using the neutron produced by high energy proton collision with heavy nuclei were investigated. Because of the small thermal neutron cross section for (n,γ) reaction of ^{137}Cs (0.1 barn), a high neutron flux of 10^{17} n/cm^2 sec is required to transmute ^{137}Cs at a rate ten times faster than the natural decay. This range of high flux is attainable in the spallation reaction of high energy proton beam interact with liquid Pb target. The neutronic calculation by using NMTC, HIST3D, EPR, TAPEMAKER and ANISN codes indicates that the spallation neutron can transmute 222 kg ^{137}Cs and 155 kg ^{90}Sr fission products per year (at a rate of 10 and 30 times faster than their natural decay rate) by running a 300 mA, 1.5 GeV proton beam. Thus, if we transmute these fission products, just after a burning cycle, this accelerator can transmute these fission products produced in five or six 1000 MWe power plants.

9547 **(LA—7444-SR(Rev.)) LAMPF: proposal status and summaries.** Rayburn, L.; Talley, B. (comps.). (Los Alamos Scientific Lab., NM (USA)). Sep 1978. Contract W-7405-ENG-36. 113p. NTIS, PC A06/MF A01.

The status of research proposals at the LAMPF is summarized to include the July 1980 PAC actions. (GHT)

9548 **(LA—8592-PR) Accelerator technology program. Progress report, January-December 1979.** Knapp, E.A.; Jameson, R.A. (comps.). (Los Alamos Scientific Lab., NM (USA)). Nov 1980. Contract W-7405-ENG-36. 226p. NTIS, PC A11/MF A01.

The activities of Los Alamos Scientific Laboratory's (LASL) Accelerator Technology (AT) Division during the calendar year 1979 are highlighted, with references to more detailed reports. This report is organized around the major projects of the Di-

vision, reflecting a wide variety of applications and sponsors. The first section covers the Fusion Materials Irradiation Test program, a collaborative effort with the Hanford Engineering Development Laboratory; the second section summarizes progress on the Proton Storage Ring to be built between LAMPF and the LASL Pulsed Neutron Research facility. A new project that achieved considerable momentum during the year is described next - the free-electron laser studies; the following section discusses the status of the Pion Generator for Medical Irradiation program. Next, two more new programs, the racetrack microtron being developed jointly by AT-Division and the National Bureau of Standards and the radio-frequency (rf) accelerator development for heavy ion fusion, are outlined. Development activities on a new type of high-power, high-efficiency rf amplifier called the gyrocon are then reported, and the final sections cover development of H^- ion sources and injectors, and linear accelerator instrumentation and beam dynamics.

9549 **(LA—8658-MS) Accelerator drift-tube braze-joint failures in the PIGMI APF cavity.** Hansborough, L.D.; Levinson, L.S.; Reiswig, R.D.; Wilkerson, L.C. (Los Alamos Scientific Lab., NM (USA)). Jan 1981. Contract W-7405-ENG-36. 21p. NTIS, PC A02/MF A01.

During the assembly of the Alternating Phase Focusing cavity for the PIGMI Prototype proton accelerator, recurring failures of drift-tube braze joints occurred. In the fabrication technique, a torch braze was used to attach the stems to both the drift-tube body and the stem termination; all materials used were stainless steel. The assemblies were copper plated, using bright-acid-leveling copper plating. Some braze joints, although satisfactorily tension-tested before plating, later failed at a relatively low loading. A detailed investigation of one drift tube indicated that residual copper-plating solution in the cooling passages acted to dissolve the braze solution over a period of weeks, leading to an eventual joint failure.

9550 **(LA-UR—80-3507) Concepts and limitations of macroparticle accelerators using travelling magnetic waves.** Wipf, S.L. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 23p. (CONF-801138—7). NTIS, PC A02/MF A01.

From Electromagnetic guns and launchers conference; San Diego, CA, USA (4 Nov 1980).

The concept of an accelerator using a travelling magnetic wave acting on magnetized projectiles is discussed. Although superconductors have a high potential as projectile material, their low critical temperature makes them unsuitable. Among ferromagnetic materials dysprosium seems to be superior. For stable suspension and guidance a high conductivity, preferably superconducting, guide sheet is necessary. Magnetic field gradients of 10^9 A/m^2 travelling at 10^6 m/s should be achievable using present state-of-the-art components; resulting accelerations are $\geqq$ 500 km/s^2. A linear accelerator for final speeds of 50 km/s needs a length of 2.5 km. Guidance forces sufficient to produce acceleration of 2 x 10^6 m/s^2 allow circular accelerators of reasonable size to achieve hypervelocities for small (50 to 100 mg) projectiles. An accelerator of 170 m diameter would surpass the best results from light gas guns. Travelling waves suitable for accelerations of the order of 10^4 m/s^2 can be produced without switching, by means of flux displacing rotors, easily adapted to circular accelerators.

9551 **(LBL—10756) Testing of accelerator dipoles in pressurized superfluid helium.** Gilbert, W.S.; Caspi, S.; Hassenzahl, W.; Lambertson, G.; Meuser, R.; Rechen, J.; Schafer, R.; Warren, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1980. Contract W-7405-ENG-48. 8p. (CONF-800740—25). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

Two superconducting accelerator dipole magnets, with different internal construction features, have been tested in pressurized superfluid helium (1.8K, 1.2 atmosphere) as well as in regular pool boiling helium (4.4K, 1.2 atmosphere) helium. The coils of one magnet were moderately pre-stressed, and 4.2K design performance was rapidly achieved in the superfluid. The other magnet had very low coil pre-stress, reduced helium ventilation, and displayed degraded performance, even in the superfluid helium.

9552 **(LBL—11639) Overview of the LBL/LLNL negative-ion-based neutral beam program.** Pyle, R.V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1980. Contract W-7405-ENG-48. 4p. (CONF-801068—16). NTIS, PC A02/MF A01.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

The LBL/LLNL negative-ion-based neutral beam development program and status are described. The emphasis has shifted in some details since the first symposium in 1977, but our overall objectives remain the same, namely, the development of megawatt d.c. injection systems. Previous emphasis was on a system in which the negative ions were produced by double charge exchange in sodium vapor. At present, the emphasis is on a self-extraction source in which the negative ions are produced on a biased surface imbedded in a plasma. A one-ampere beam will be accelerated to at least 40 keV next year. Studies of negative-ion formation and interactions help provide a data base for the technology program.

9553 **(LBL—11808) Dedicated heavy ion medical accelerators.** Gough, R.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1980. Contract W-7405-ENG-48. 24p. (CONF-8010115—3). NTIS, PC A02/MF A01.

From MARIA workshop on accelerator systems for relativistic heavy ions in medical and scientific research; Edmonton, Alberta, Canada (20 Oct 1980).

This paper outlines technological considerations in the design of accelerator facilities for medical applications. Emphasis is placed on the specific requirements for MARIA, a radioisotope and radiotherapy facility being planned in Edmonton, Canada. The material draws heavily on LBL experience (refs. 1,2,3) and addresses various accelerator components, including ion sources, injectors and synchrotrons. Requirements for the control system and considerations of facility layouts are also discussed.

9554 **(LBL—11824) Large-aperture D^- accelerators.** Anderson, O.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1980. Contract W-7405-ENG-48. 7p. (CONF-801068—22). NTIS, PC A02/MF A01.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

Accelerator designs are described for D^- produced by double charge exchange, by the ion magnetron, and by the LBL bucket source; in all three cases the accelerators employ a single slot per module. High and low energy designs are discussed; in the latter cases the perveances are much larger than in typical D^+ accelerators.

9555 **(SAND—80-1405) Operation manual for Sandia MA165 neutron generator system.** Rice, L.G. III. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 61p. NTIS, PC A04/MF A01.

The Sandia MA165 Neutron Generator System was designed for use in the Sandia Safeguards Unattended Equipment/Material Pass-Through. As this neutron generator system design evolved, it became simpler to use while it also became more versatile. Two operations which were previously controlled manually by the operator were automated in the new design. Its stand alone characteristic has allowed it to become a versatile laboratory tool. Los Alamos National Scientific Laboratory and Brookhaven National Laboratory are both currently using versions of the MA165 system for their research. Aside from power supplies, the system consists of a neutron generator package and an electronic control chassis. This manual describes, in detail, the neutron generator package, the theory of operation of the electronic control chassis, and instructions for using the MA165 system.

9556 **Pulsed plasma guns for intense ion beam injectors.** Humphries, S. Jr.; Anderson, R.J.M.; Freeman, J.R.; Greenly, J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00889. *Review of Scientific Instruments, The (U.S.);* **52**: No. 2, 162-171(Feb 1981).

Plasma guns designed to provide high-pulsed fluxes of ions for intense ion beam injectors are described. The guns use pulsed

radial magnetic fields to accelerate ions longitudinally into magnetically insulated extraction gaps. Plasma was supplied using both spark sources and pulsed gas injection. In typical operation, a 1-Ω pulse of nitrogen ions with an ion flux equivalent to 50 A/cm² was produced. A variety of ions ranging in mass from protons to argon was investigated.

44 INSTRUMENTATION

4401 Radiation Instrumentation

9557 (BNL—28850) Semiconductor devices as track detectors in high energy colliding beam experiments. Ludlam, T. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 14p. (CONF-801103—47). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

In considering the design of experiments for high energy colliding beam facilities one quickly sees the need for better detectors. The full exploitation of machines like ISABELLE will call for detector capabilities beyond what can be expected from refinements of the conventional approaches to particle detection in high energy physics experiments. Over the past year or so there has been a general realization that semiconductor device technology offers the possibility of position sensing detectors having resolution elements with dimensions of the order of 10 microns or smaller. Such a detector could offer enormous advantages in the design of experiments, and the purpose of this paper is to discuss some of the possibilities and some of the problems.

9558 (COO—3072-119) Results on the performance of a broad band focussing Cherenkov counter. Cester, R.; Fitch, V.L.; Montag, A.; Sherman, S.; Webb, R.C.; Witherell, M.S. (Princeton Univ., NJ (USA). Dept. of Physics). 1980. Contract AC02-76ER03072. 8p. (CONF-801103—49). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

The field of ring imaging (broad band differential) Cherenkov detectors has become a very active area of interest in detector development at several high energy physics laboratories. Our group has previously reported on a method of Cherenkov ring imaging for a counter with large momentum and angular acceptance using standard photo multipliers. Recently, we have applied this technique to the design of a set of Cherenkov counters for use in a particle search experiment at Fermi National Accelerator Laboratory (FNAL). This new detector operates over the range $0.998 < \beta < 1.000$ in velocity with a $\delta\beta \sim 2 \times 10^{-4}$. The acceptance in angle is +- 14 mrad in the horizontal and +- 28 mrad in the vertical. We report here on the performance of this counter.

9559 (LBL—10726) Fabrication techniques for reverse electrode coaxial germanium nuclear radiation detectors. Hansen, W.L.; Haller, E.E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1980. Contract W-7405-ENG-48. 4p. (CONF-801103—41). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

Germanium detectors with reverse polarity coaxial electrodes have been shown to exhibit improved resistance to radiation damage as compared with conventional electrode devices. However, the production of reverse electrode devices involves the development of new handling and fabrication techniques which has limited their wider application. We have developed novel techniques which lead to a device which is simple to fabricate, environmentally passivated and surface state adjusted.

9560 (LBL—11766) Gamma-ray detection with PbO glass converters in MWPC: electron conversion efficiency and time resolution. Lum, G.K.; Perez-Mendez, V.; Sleaford, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., San Francisco (USA). Dept. of Radiology). Nov 1980. Contract W-7405-ENG-48. 11p. (CONF-801103—42). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

The development of glass tube converters for efficient gamma-ray detection in multi-wire proportional chambers (MWPC) has led to an investigation of the improvement of conductivity on glass surfaces and to an investigation of gas mixtures which will improve on the electron conversion efficiency and electron transit time within the tubes. Efforts to establish uniform electric field lines within small diameter tubes has resulted in an improved H_2 reducing treatment. For a 2 cm thick converter made of glass tubing (0.9 mmID;1.10 mmOD) the electron conversion efficiency ϵ was measured to be 9.0% and 10.4% at 511 keV, using Ar mixtures containing 10% CF_4 and 30% isobutane, respectively. The effects of gas mixtures on ϵ and on tau, the mean transit time on conversion electrons within the converter, and the projection of these results to the performance of a modified MWPC positron camera are presented.

9561 Directional-correlation results for ^{134}Ba and ^{110}Cd using a megachannel gamma-gamma coincidence system. Ruhter, W.D.; Camp, D.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *Nuclear Instruments amp Methods (Netherlands);* **173**: No. 3, 489-503(Jul 1980).

The development of high-resolution Ge(Li) detectors has created a need for gamma-ray coincidence analysis systems able to process and store the large quantities of data generated. We describe a megachannel pulse-height analysis system that can sort and store these data on line. This is accomplished using a 32 K-word PDP-8/E minicomputer and two moving-head disks that provide a storage capacity of 2^{18} events at any of 2^{20} data locations. An X-or Y-pulse-height spectrum, in coincidence with one to four arithmetically combined pulse-height peak and background windows, can be assembled for CRT display and spectral analysis within 2-20 s. The rapid recovery of data allows convenient set-up and monitoring of experiments and analysis of the accumulated data. To test the performance of the system, we made directional-correlation measurements on gamma-ray cascades in ^{134}Ba and ^{110}Cd. Analysis of these data gave E2/M1 mixing ratios that for most transitions agreed well with published results. Using this system with its improved energy resolution and data processing capabilities, we obtained new E2/M1 mixing ratio results of 13.3 +- 2.1 for the 563 keV transition in ^{134}Ba and -1.24 +- 0.20 for the 1505 keV transition in ^{110}Cd.

9562 Multistage parallel-serial time averaging filters. Theodosiou, G.E. (Argonne National Lab., IL (USA). High Energy Physics Div.). *Nuclear Instruments amp Methods (Netherlands);* **173**: No. 3, 577-583(Jul 1980).

Here, a new time averaging circuit design, the 'parallel filter' is presented, which can reduce the time jitter, introduced in time measurements using counters of large dimensions. This parallel filter could be considered as a single stage unit circuit which can be repeated an arbitrary number of times in series, thus providing a parallel-serial filter type as a result. The main advantages of such a filter over a serial one are much less electronic gate jitter and time delay for the same amount of total time uncertainty reduction.

9563 Thermoluminescent response of LiF and $Li_2B_4O_7$: Mn to pions. Cooke, D.W. (Los Alamos Scientific Lab., NM (USA)); Hogstrom, K.R. (New Mexico Univ., Albuquerque (USA)). *Physics in Medicine and Biology (England);* **25**: No. 4, 657-666(Jul 1980).

LiF (TLD-100, TLD-600, and TLD-700) and $Li_2B_4O_7$: Mn (TLD-800) have been exposed to π^+ and π^- beams over the clinically useful range of 0.05-4Gy (5-400 rad). Thermoluminescence response curves were determined for the 200 and 260°C glow peaks in LiF and for the 200°C peak in $Li_2B_4O_7$ when the dosemeters were exposed in the peak and plateau regions of the Bragg curve. TLD-700 appears to be suited for use in pion dosimetry since it is capable of measuring both total and high-LET dose by utilising the 200 and 260°C peaks. TLD-100, TLD-600, and TLD-800 will not be useful because the neutrons emitted from π^- capture result in an enhanced dose to the thermoluminescence dosemeters via (n,α) ions which cannot be extracted from the data. Linearity and fading of each glow peak was also investigated.

9564 Depth dose and off-axis characteristics of TLD in therapeutic pion beams. Hogstrom, K.R. (New Mexico Univ., Albuquerque (USA)); Irifune, T. (Los Alamos Scientific Lab., NM (USA)). *Physics in Medicine and Biology (England);* **25**: No. 4, 667-676(Jul 1980).

The thermoluminescent (TL) response of LiF (TLD-100, TLD-600, TLD-700) and $Li_2B_4O_7$ (TLD-800) has been measured as a function of depth and off-axis position in a therapeutic negative-pion beam in order to evaluate their usefulness in pion radiotherapy. TLD-100, TLD-600, and TLD-800 have been shown to be of little use as in vivo dosemeters because the neutron kerma relative to that in tissue changes grossly with depth. The neutron source comes primarily from pion absorption in the lead-alloy collimator. The 200°C TLD-700 response agrees well with the depth dose spectra, except for small changes due to the varying linear energy transfer (LET) distributions. This variation can be partially accounted for by incorporating the known LET response of LiF. The 260°C peak of TLD-700 has been found to be approximately four times more sensitive than the 200°C peak to high LET dose. Using a simple model of the LET responses, the measured 200 and 260°C peaks predict total dose within +-4% and high LET dose within +-50%, therefore indicating TLD-700 to be a good in vivo dosemeter for total dose but only an indicator of high LET dose.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 9960

9565 (DOE/ER/10348—3) Micromagnetic susceptometer for the measurement of the magnetic susceptibility of the actinides. Nave, S.E. (Tennessee Univ., Knoxville (USA)). Aug 1979. Contract AS05-79ER10348. 72p. NTIS, PC A04/MF A01.

Thesis.

A device with the sensitivity for measuring the magnetic susceptibility of small volume samples (10^{-7} cm^3) as a function of temperature from 4.2K to 300K is described as designed specifically for measurements with microgram or submicrogram quantities of the actinide metals. Specifically, results are given for the susceptibility of curium-248 in the temperature range from 4.2K to 300K.

9566 (DOE/ER/10348—12) Calculator thermometer. Huray, P.G.; Nave, S.E. (Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy; Oak Ridge National Lab., TN (USA)). 1979. Contract AS05-79ER10348. 12p. NTIS, PC A02/MF A01.

An inexpensive substitution for calibrated thermocouples, linearizing electronics, and the NBS thermocouple tables is obtained through the use of a hand-held calculator. Automatic offset corrections and interpolations to an output temperature are possible in a one button operation beginning with voltmeter EMF. The inverse operation is also given. Appropriate constants have been found for the Cu-constantan, iron-constantan, and chromel-alumel thermocouples.

9567 (ENICO—1073) Digiquartz pressure transducer calibration test results. Bentzen, F.L. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Dec 1980. Contract AC07-79ID01675. 49p. NTIS, PC A03/MF A01.

The safeguarding of strategic nuclear material in chemical fuel reprocessing plants requires the accurate determination of liquid level, which is translated to pressure through bubbler probes. To measure the pressure with sufficient accuracy requires transducers better than standard process units. The Paroscientific Inc. Digiquartz transducer meets the requirement when calibrated. Calibration was accomplished with an automatic data acquisition system using a Hewlett Packard 9825A computer and associated precision laboratory equipment and a Ruska DDR 6000 pressure calibrator. Data were taken from 0 to 15 psid over the range of 15 to 60°C for 14 pressure transducers.

9568 (LBL—11036) Optimum filter for determination of the position of an arbitrary waveform in the presence of noise. Llacer, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1980. Contract W-7405-ENG-48. 5p. (CONF-801103—44). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

This paper presents a general approach to solving the problem of defining the time of arrival of a signal in the noise, or the similar one of defining the position of a peak in a histogram. In particular, it solves the problem of a signal in white noise, giving the well known result that the optimum filter before a zero crossing discriminator should have an impulse response function equal to the derivative of the waveform to be observed. It then solves the problem of estimating the position of a pea in a histogram in wich the number of counts in each bin has a variance equal to the number of counts in that same bin. The resulting optimum filter is the derivative divided by the function itself. Examples of applying the results are given and the uniqueness of the solution to the set of non-linear simultaneous equations resulting from the problem is demonstrated.

9569 (LBL—11818) HISS spectrometer at LBL. Greiner, D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1980. Contract W-7405-ENG-48. 33p. (CONF-801054—1). NTIS, PC A03/MF A01.

From Institute for Reactor Safety meeting; Munich, F.R. Germany (31 Oct 1980).

The Heavy Ion Spectrometer System at LBL is designed to be a general purpose experimental work bench able to support a wide variety of experiments. Our philosophy is to provide instruments capable of investigating, with multi-particle sensitivity, a large portion of phase space. We have not chosen a particular region such as mid-rapidity or projectile frame but, instead, have made sure that the magnet and the instrumentation allow these choices as well as many others. The beam can be brought into the magnet at a variable position and the magnet can be rotated.

9570 (SAND—80-1909) Transient analysis of vibrations in nonideal multilayered piezoelectric devices. Hodgdon, M.L. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 30p. NTIS, PC A03/MF A01.

A numerical method of solving the equations involved in the transient vibration analysis of nonideal multilayered piezoelectric is presented. The use of the computer code WONDY IV in obtaining the solution, a numerical example and experimental data is described. In addition, a method is included for approximating the values of creep or relaxation functions from steady-state attenuation data.

9571 (SLAC-PUB—2370) Beam envelope matching for beam guidance systems. Brown, K.L. (Stanford Linear Accelerator Center, CA (USA)). Aug 1980. Contract AC03-76SF00515. 32p. (CONF-800952—4). NTIS, PC A03/MF A01.

From International conference on charged particle optics; Giessen, F.R. Germany (8 Sep 1980).

Ray optics and phase ellipse optics are developed as tools for designing charged particle beam guidance systems. Specific examples of basic optical systems and of phase ellipse matching are presented as illustrations of these mathematical techniques.

9572 Simplified technique for measuring specific heat and thermal conductivity of a liquid under pressure. Allen, P.C.; Paulson, D.N.; Wheatley, J.C. (Department of Physics, University of California, San Diego, La Jolla, California 92093). DE-AT03-76ER70143. *Review of Scientific Instruments, The (U.S.);* **52**: No. 2, 310-313(Feb 1981).

A technique for simultaneously measuring the specific heat and the thermal conductivity of a liquid over a broad range of pressure is described. The technique uses a system in which the liquid circulates in a pulsating manner through a counter-current heat exchanger, or regenerator, made of parallel plates and thereby achieves the advantage of a continuous flow method where parasitic heat losses may be readily identified and eliminated. Typical results for water at 28 bar and propylene at 34.5 bar are presented.

9573 Ultra-linear pulser for testing fast integrating ADCs. Dawson, J.W.; Loos, J.S. (Argonne National Lab., IL (USA)). *Nuclear Instruments amp Methods (Netherlands);* **173**: No. 3, 613-615(Jul 1980).

A simple pulser employing a VMOS FET has been built and tested. Over the range of injected charge from 15 to 500 pC, the pulser is found to be linear to better than 0.04%.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 9589

9574 (AD-A—082610) Chemical initiation of FAE clouds. Annual interim report, September 1978-September 1979. von Elbe, G.; McHale, E.T. (Atlantic Research Corp., Alexandria, VA (USA). Combustion and Physical Science Dept.). Nov 1979. Contract F49620-77-C-0097. 37p. NTIS, PC A03/MF A01.

Laboratory experiments with liquid fuel and ClF3 (CTF) or BrF3 (BTF) have suggested that an effective FAE blast may be obtained by very rapid fuel/agent dispersion and agent-induced combustion. In the current work, initial small-scale field tests using small pellets of high-explosive for fuel and agent dispersion have yielded significant FAE blasts when performed in open air, no blast when performed in an atmosphere of nitrogen, and a very strong blast when performed in an atmosphere of oxygen. The results show that an agent such as CTF meets the requirements of inducing very rapid combustion, and that the strength of the FAE blast is thus principally governed by the size and configuration of the central dispersing charge. Further small-scale tests are scheduled in which the central charge is substantially enlarged and shaped for injecting high velocity jets of fuel/agent dispersion into the surrounding atmosphere.

9575 (LA—8551-MS) Storage stability of X-0298: a rubber-bonded HMX-based explosive. Loughran, E.D. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 8p. NTIS, PC A02/MF A01.

The storage stability at elevated temperatures of X-0298, a rubber-bonded HMX composition, was determined. After 34 months in sealed containers at 40, 50, and 60°C, physical properties of tensile specimens exhibited no significant degradation. Gas evolution rates from small cylinders of X-0298 stored in air-filled ampoules at 60, 75, and 90°C were 30, 80, and 1000 $cm^3/kg/yr$. Compared with other energetic explosives, X-0298 is exceptionally stable when stored at temperatutres below 60°C.

9576 (MHSMP—81-02) Use of flowing afterglow technique for the analysis of moisture in TATB formulations. Process development (Endeavor No. 205). Copeland, R.J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Jan 1981. Contract AC04-76DP00487. 13p. NTIS, PC A02/MF A01.

A system utilizing the Flowing Afterglow technique has been built in order to test its applicability as a tool for the quantitative analysis of moisture in TATB powders and TATB formulations. The system parameters were optimized and the afterglow was calibrated using a hydrated salt ($CaSO_4$ $2H_2O$) as the moisture standard. A test group of TATB formulations was analyzed with this technique. The moisture content of the samples ranged from 0.008 to 0.029% (80 to 290 ppM). The results were also compared to other methods of analysis, such as Karl-Fischer, Total Volatiles and CEC (electrolytic cell).

9577 (MHSMP—81-03) Computer programs for acquisition and analysis of mallet impact data. Process development (Endeavor No. 301). Ashcraft, R.W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Jan 1981. Contract AC04-76DP00487. 24p. NTIS, PC A02/MF A01.

Two computer programs developed for the Hewlett-Packard timing and recording system are discussed. The first, written for the HP-9835, is used at the firing site to acquire the data from a Biomation 8100 waveform recorder and store the data on a magnetic tape. Limited data analysis is included with this program. The second program, written for the HP-9845, retrieves the data from the magnetic tape and performs the data reduction and analysis. Both programs are written in HP Basic. Program listings and sample output are included in the appendices.

9578 (MLM—2798(OP)) Overview of surface studies on high energy materials at Mound. Moddeman, W.E.; Collins, L.W.; Wang, P.S.; Haws, L.D.; Wittberg, T.N. (Mound Facility, Miamisburg, OH (USA); Dayton Univ., OH (USA). Research Inst.). 1980. Contract AC04-76DP00053. 51p. (CONF-801074—2). NTIS, PC A04/MF A01.

From 8. annual DOE compatibility meeting; Los Alamos, NM, USA (14 Oct 1980).

Portions of document are illegible.

Since 1975 Mound has been examining the surface structure of high energy materials and the interaction of these materials with various metal containers. The high energy materials that have been studied include: the pyrotechnic TiH/sub x//$KClO_4$, the Al/Cu_2O machinable thermite, the PETN, HMX and RDX explosives, and two plastic bonded explosives (PBX). Aluminum and alloys of Fe, Ni and Cr have been used as the containment materials. Two aims in this research are: (1) the elucidation of the mechanism of pyrotechnic ignition and (2) the compatibility of high energy materials with their surroundings. New information has been generated by coupling Auger electron spectroscopy (AES) and x-ray photoelectron spectroscopy (XPS) with thermal data. In particular, AES and XPS studies on the pyrotechnic materials and on thermites have shown the mechanism of ignition to be nearly independent of the type of oxidizer present but directly related to surface chemistry of the fuels. In studies on the two PBX's, PBX-9407 and LX-16, it was concluded that the Exon coating on 9407 was complete and $\geq$ 100A; whereas in LX-16, the coating was $<$ 100A or even incomplete. AES and scanning Auger have been used to characterize the surface composition and oxide thickness for an iron-nickel alloy and showed the thicker oxides to have the least propensity for atmospheric hydrocarbon adsorption. Data are presented and illustrations made which highlight this new approach to studying ignition and compatibility of high energy materials. Finally, the salient features of the X-SAM-800 purchased by Mound are discussed in light of future studies on high energy materials.

9579 Polymeric coatings effect on surface activity and mechanical behavior of high explosives. Bower, J.K.; Kolb, J.R.; Pruneda, C.O. (Lawrence Livermore National Lab., CA). *Industrial and Engineering Chemistry, Product Research and Development (U.S.);* **19**: No. 3, 326-329(1980).

There is a continuing effort at Lawrence Livermore National Laboratory to formulate new plastic-bonded explosives (PBX) with enhanced energy and improved safety characteristics. We have found that these parameters depend mainly upon the polymer or plastic chosen as binder. Typically, these materials have 5 to 10 vol % polymer and the explosive may be treated as a solid coated with a polymeric film. In an effort to determine which properties of a polymer are advantageous here, we have examined in depth three polymers (Kel-F 800, Phenoxy PKHJ, and Kraton G 1650) and an insensitive explosive (1,3,5-triamino-2,4,6-trinitrobenzene (TATB)). We determined mechanical and rheological properties, surface characteristics, and acid-base behavior of the pure materials and composites (PBX). It was found that extensibility, glass transition temperature, and Lewis acidity surface wettability of the components of a PBX are governing factors in safety characteristics. 7 tables.

4502 Nuclear

9580 (AD-A—082693) The Foulness multiton air blast simulator. Part 3. Blast wave formation and methods used to drive the simulator. Clare, P.M. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Mar 1980. 34p. NTIS, PC A03/MF A01.

The various techniques used to drive the Foulness multiton air blast simulator and obtain optimum performance are described. These involve boosting the total energy release of the explosive driver using expanded polystyrene and at the same time, controlling the rate of release. The part played by aqueous foam in minimising irregularities in waveform also is described.

9581 **(AD-A—083072) Federal Aviation Administration electromagnetic pulse (EMP) protection study: a reexamination and update.** Chen, C.; Peele, W.D. (Rome Air Development Center, Griffiss AFB, NY (USA)). Nov 1979. Contract DOT-FA72WAI-356. 160p. NTIS, PC A08/MF A01.

In 1972, a study was performed to assess the susceptibility of the FAA system to the electromagnetic pulse (EMP) phenomenon. The purpose of the present investigation is to update the previous study by incorporating existing and newly published results of EMP and its effect on new equipment. The particular EMP model which has been used is based upon the environment anticipated for a typical high altitude nuclear burst. Our method of susceptibility assessment of the system has been to determine the effectiveness of protection at each of the various types of facilities in the FAA system. These have included the control centers and supporting computer, the remote radars, short range radars, RCAG sites, the remote microwave relay sites (RML), control towers, RVR, Instrument Landing Systems, IFR rooms and related computers (ARTS III), runway and approach light systems. No effort was made to determine the susceptibility of the ATandT long lines system which supports the communications and radar data functions. At least one of each of these types of FAA facilities has been analyzed to determine effectiveness of existing building shielding (including nonconductive penetrations), the adequacy of protective devices on conductive penetrations, the adequacy of the grounding system, and the susceptibility of existing equipment to the EMP environment. The EMP threat is actually a subset of the total Electromagnetic Radiation (EMR) problem which can be overviewed as shown here.

9582 **(AD-A—083295) Post-shot blast loading predictions for German structure number 2. DICE THROW EVENT. Final report.** Coulter, G.A. (Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab.). Mar 1980. 25p. NTIS, PC A02/MF A01.

Pressure-time blast loading post-shot predictions are presented for German Structure No. 2 exposed on the Dice Throw Event. Loading curves are shown for front, side and interior structure locations.

9583 **(AD-A—083332) Laboratory studies of containment in underground nuclear tests. Final report, 16 November 1977-31 January 1979.** Cizek, J.C.; Florence, A.L. (SRI International, Menlo Park, CA (USA)). 31 Jan 1979. Contract DNA001-77-C-0025. 143p. NTIS, PC A07/MF A01.

As part of the DNA stemming and containment program for underground nuclear testing, laboratory studies were performed to further develop and apply experimental techniques for assessing the effects on containment of the residual stress field surrounding an exploded cavity. A comparison of hydrofracture pressures for exploded and unexploded cavities revealed the existence of this stress field. Experimental parameter studies were conducted to provide an understanding of the mechanisms controlling containment. Sensors were developed to generate quantitative estimates of crack growth, fluid motion, and the states of stress and strain in the region surrounding a cavity during hydrofracture. The data generated provide results suitable for development of new containment theories as well as for correlation with predictions of existing computer codes. Hydrofracture pressure records were simulated by applying classical fracture mechanics theory.

9584 **(AD-A—083334) Source pressure and flow sample measurements on DABS tests S2 and S3. Final report, 14 April 1977-30 June 1978.** Keough, D.D.; Hall, L.B.; Gates, R.W. (SRI International, Menlo Park, CA (USA)). 1 Jan 1979. Contract DNA001-77-C-0219. 68p. NTIS, PC A04/MF A01.

Air shock pressure-time histories were measured in the HE source region of the Air Force Weapons Laboratory (AFWL) DABS S2 test to determine source characteristics. Steel-ytterbium flatpack gages previously used for the measurement of soil stress were modified, and static, uniaxial strain calibration was performed at pressures to approximately 8 MPa. Results of static calibration at these low pressures and low strain rates agreed well with values extrapolated from high stress (500 MPa) uniaxial strain, shock data, indicating no strain rate effects in the ytterbium piezoresistance sensor and definable response if the tensor state of strain is carefully controlled. The gages survived the environment in the DABS test within 3 m of the HE source and indicated a double shock structure with peak pressures of up to 98 MPa, possible slight prepressurization of the source chamber by the primacord initiation system, less than 5% skewing of the air shock, and slightly higher pressures along the tube axis. Postshot measurement of the gage resistance showed that, for gages in which gross damage did not occur, the pre- and postshot values agreed within a few percent, indicating no gage hysteresis. Flow samplers consisting of steel tubes explosively closed at the ends during shock flow were fielded at two stations, 19 and 26 m on DABS S3 to determine the particulate matter concentration and for comparison of particulate matter arrival time with previously observed pressure variations.

9585 **(AD-A—083337) DIABLO HAWK EVENT, cavity pressure sensors package ground shock isolation experiment. Final report, 20 June 1977-30 November 1978.** Day, E.A.; Ginn, W.G. (Systems, Science and Software, La Jolla, CA (USA)). 30 Nov 1978. Contract DNA001-78-C-0166. 31p. NTIS, PC A03/MF A01.

DIABLO HAWK was an underground tunnel test to investigate the effects of a nuclear explosion on various structures and systems. Systems, Science and Software fielded an experiment to demonstrate the feasibility of mounting pressure gauges with built-in electronics in a manner to effectively isolate the ground shock and permit continuous output (pressure reading) for a period starting prior to zero time and continuing until power is terminated at the recording trailers. The shock isolation package was mounted to the end-of-stemming bulkhead located in the TAPS crosscut (the cross-drift leading to the TAPS from the by-pass drift). To evaluate the effectiveness of the shock isolation system, two high g rated accelerometers were attached to the stemming bulkhead and two lower rated accelerometers were attached inside the package. Continuous signals were recorded from each of the four accelerometers as well as from the two pressure gauges from minus two minutes until the recording trailer power was terminated at plus five minutes. The two bulkhead-mounted accelerometers showed good agreement with groundshock arrival at 72 ms after zero time and a peak acceleration of 71g. Inside the shock isolated package the first acceleration was recorded at 77 ms and the peak acceleration was 10.8g. The two package mounted accelerometer signals were essentially identical.

9586 **(AD-A—083339) The ROSCOE manual. Volume 24. Natural clouds (physical and optical properties and statistics). Final report, 1 January 1976-31 July 1979.** Johnston, R.R.; Stevenson, D.E.; Aron, W.A.; Moffat, R.D.; Hamlin, D.A. (Science Applications, Inc., La Jolla, CA (USA)). 31 Jul 1979. Contract DNA001-76-C-0194. 276p. NTIS, PC A13/MF A01.

The effect of natural clouds on IR observables from nuclear explosions is modeled for the wavelength range from 2 to 5 microns. A computer code for use with the ROSCOE-IR main program is provided to allow evaluation of the radiance resulting from transmission and reflection by natural clouds. Mie scattering cross-sections are calculated and used to generate transport cross-sections and bidirectional reflectance coefficients. Cloud transmission is treated by diffusion. A deterministic model allows the user to specify the cloud geometry. A statistical model allows selection of geographic weather averages and generates the probability distribution in radiance coefficients. Solar radiation and natural cloud thermal emission are treated.

9587 **(AD-A—083340) A high altitude ionization structure and scintillation model. Final report, 1 May 1978-31 January 1979.** Sachs, D.L. (Science Applications, Inc., La Jolla, CA (USA)). 19 Feb 1979. Contract DNA001-78-C-0196. 41p. NTIS, PC A03/MF A01.

A method is described for the implementation of a time dependent striation structure and convection model into an existing systems code. The purpose is to update estimates of the scintillation effects of the structuring of the ionization of high altitude nuclear bursts on satellite radio signals. The structure and convection model is an extrapolation of the results of a numerical calculation

for an idealized situation to the nuclear case combined with a late time bifurcation model.

9588 **(AD-A—083436) Post-test blast response analyses of DICE THROW vehicles. Final report, 26 July 1977-1 March 1978.** Wetmore, K.R. (Kaman Avidyne, Burlington, MA (USA)). Jan 1980. Contract DAAD05-74-C-0744. 125p. NTIS, PC A06/MF A01.

This report summarizes the results of a blast response study of select truck configurations fielded in the DICE THROW test. Using the TRUCK computer code, the response time-histories of four different Army wheeled vehicle systems exposed to both blast overpressure and dynamic pressure loadings were obtained. Important motions of the total systems subsequent to blast wave interception, particularly vehicle overturning, are plotted.

9589 **(AD-A—083451) Medium frequency propagation experiment at MISERS BLUFF. Topical report, 15 July-15 November 1978.** Vickers, R.S. (SRI International, Menlo Park, CA (USA)). 15 Nov 1978. Contract DNA001-77-C-0269. 34p. NTIS, PC A03/MF A01.

In an experiment conducted in conjunction with the MISERS BLUFF high-explosive detonation, the effects of the dust cloud on wave propagation at 3 MHz were assessed. The experiment used both vertical above-ground and horizontal buried antennas. The results indicate that the dust from this 720-ton ANFO detonation caused no appreciable propagation effects, as expected, although the shock wave perturbed communications for several seconds.

9590 **(AD-A—083453) Static tests of segments of tunnel linings. Volume II. Data. Final report, 14 February 1977-30 June 1979.** Davis, H.C.; Morrill, K.B.; Merritt, J.L. (Merritt Cases, Inc., Redlands, CA (USA)). 30 Jun 1979. Contract DNA001-77-C-0143. 413p. NTIS, PC A18/MF A01.

Volume II presents the complete set of laboratory data obtained from the initial series of 16 quasi-static tests of segments of cylindrical tunnel linings. Test specimens included scale models of two composite integral structures fielded in the MIGHTY EPIC Structures Experiment as well as two new structural concepts: the compliant liner and the voussoir block liner.

9591 **(AD-A—083485) DNA EMP awareness course notes. Supplement to third edition. Topical report, January-July 1978.** Mindel, I.N. (IIT Research Inst., Chicago, IL (USA)). 31 Jul 1978. Contract DNA001-78-C-0004. 36p. NTIS, PC A03/MF A01.

These notes are primarily intended as a guide for the individual attending the DNA EMP Awareness Course. The text serves as an engineering introduction to the EMP systems design problem and provides a survey of techniques suitable for solving this hardening problem. The text discusses all aspects of EMP, from the environment through system design and testing.

9592 **(AD-A—083520) LOWTHRM: a thermal fluence code. Master's thesis.** Westbrook, C.R. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1980. 74p. NTIS, PC A04/MF A01.

A Fortran computer program LOWTERM is described for calculating nuclear thermal fluence incident upon a target area. Atmospheric transmissivity factors in the spectral region 0.25 to 28.5 microns are determined through use of the LOWTRAN5 computer code. The program provides a choice of six model atmospheres covering seasonal and latitudinal variations from sea level to 100 km, eight haze models, and accounts for molecular absorption, molecular scattering, and aerosol extinction. Atmospheric refraction, earth curvature effects, thermal scattering, and thermal ground reflection contributions are included.

9593 **(AD-A—085255) Finite-element calculations of FOAM HEST 1. Final report, October 1978-February 1979.** Windham, J.E. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Structures Lab.). Apr 1980. 121p. NTIS, PC A06/MF A01.

The results of analytical studies in which the HONDO dynamic finite-element (FE) code was to perform (1) a two-dimensional (2D), plane-strain calculation of the Foam HEST 1 test event, (2) a second 2D calculation identical with the first except that the backfill properties were changed from those of the sand used in Foam HEST 1 to those of a hypothetical low-strength clay, and (3) companion 1D calculations for a section through the backfill, a section through the center of the roof, and a section through the sidewall of the structure. For locations in the backfill above and/or well away from the structure, vertical stress-time histories from the 2D calculation were in good agreement with those measured by the vertically oriented stress gages in Foam HEST 1. Early-time particle velocity comparisons in the sand backfill were reasonably good, but the measurements after about 5 ms appear to have been significantly influenced by relatively compressible native soil materials beneath the backfill which were not modeled as such in the calculation. The peak stress and impulse delivered to the center of the roof were higher for the clay backfill calculation than for the sand backfill calculation. For shallow depths in the backfill, the agreement between 1D and 2D calculations of vertical stress was excellent for both sand and clay; for deeper locations in the clay, the 2D calculation histories were significantly altered by waves coming through the native soil ahead of those traveling directly through the backfill.

4503 Explosion Detection

9594 **(AD-A—082886) Special data collection system. Final report, October 1977-November 1979.** Sherwin, J.R.; Kraus, G.C. (Teledyne Geotech, Garland, TX (USA)). 30 Nov 1979. Contract F08606-78-C-0011. 35p. NTIS, PC A03/MF A01.

The Special Data Collection System (SDCS) program, is an extension of work begun under the Long-Range Seismic Measurements (LRSM) program in 1960. The work is directed primarily toward collection of high quality seismic data for the development of seismic techniques necessary to detect and identify underground nuclear explosions. In addition, the program also involves related special studies such as instrumentation development and special field studies using the equipment and capabilities of the program.

9595 **(AD-A—084739) Application to two mutivariate classification techniques to the problem of seismic discrimination. Master's thesis.** Bell, A.G.R. (Pennsylvania State Univ., University Park (USA). Dept. of Geosciences). Aug 1978. 179p. NTIS, PC A09/MF A01.

Two multivariate classification methods have been applied to discriminant variables measured on a set of 20 Nevada Test Site (NTS) underground nuclear explosions and 27 North American Earthquakes. The classification methods used in this study are cluster analysis, and linear and quadratic multiple discriminant analysis. Discriminant analysis requires that the parameters of the underlying stochastic model be specified a priori, which is usually accomplished with a sample training set of events. Cluster analysis, however, follows a non-parametric approach and requires no prior information. The discriminant variables are the seven energy ratios calculated for these events by Booker and Mitronovas (1964). An additional discriminant variable, M(s)/m(b) was estimated for a reduced set of nine earthquakes and 21 underground explosions. Four M(s)/m(b) estimates were obtained for each event in this subset by randomly generating M(s) estimates within four specified variance levels about the M(s) versus M(b) lines given by Alexander and Lambert (1973). The variances used in generating the M(s) estimates are multiples of the variance found by von Seggern (1972) to be representative of M(s) measurements for NTS explosions.

9596 **(AD-A—085014) A comparison of teleseismic p wave amplitudes and spectra observed at selected basin and range sites and in Eastern North America. Phase 1. Volume 1. Final report.** Der, Z.A.; Dawkins, M.S.; McElfresh, T.W.; Goncz, J.H.; Gray, C.E. (Teledyne Geotech, Alexandria, VA (USA). Seismic Data Lab.). 30 May 1978. Contract F08606-78-C-0007. 87p. NTIS PC MF A01.

Three Seismic Data Collection System (SDCS) stations were deployed at the Nevada Test Site (NTS) and two in the Eastern United States (EUS) to measure magnitude residuals and spectral differences between NTS and EUS stations. The deployment was intended to determine the degree of anelastic attnuation under

NTS. At the Climax Stock (OB2NV) station, the teleseismic body-wave magnitudes are .17 magnitude units (m.u.) lower than at the EUS stations. The magnitudes at the two Pahute Mesa sites are about .2 m.u. higher than at OB2NV, a difference that can be accounted for by amplification of low velocity volcanics under Pahute Mesa. Thus local geology must be taken into account in order to evaluate the attenuation under a given site using amplitude data. This correction shows that with respect to corrected amplitude levels OB2NV is equivalent to Pahute Mesa stations. At all NTS sites the higher frequency content of P waves is significantly less than in the EUS. Available data suggests an attenuation effect of about .2 m.u. under NTS. Measurements at a few other Western United States (WUS) sites, including the site of the SHOAL explosion, yield similar figures. These results confirm that body-waves suffer considerable anelastic losses traversing the mantle under the WUS, including the NTS sites.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 9616, 9684, 9685, 9719, 9744, 9968

9597 (BNL—28555) Atmospheric boundary layer processes during a total solar eclipse. SethuRaman, S.; Prabhu, A.; Narahari Rao, K.; Narasimha, R. (Brookhaven National Lab., Upton, NY (USA); Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering). 1980. Contract AC02-76CH00016. 4p. (CONF-810306—5). NTIS, PC A02/MF A01.

From 5. symposium on turbulence, diffusion, and air pollution; Atlanta, GA, USA (9 Mar 1981).

The total solar eclipse that occurred over the southern part of India on February 16, 1980, gave a unique opportunity to study the earth's atmospheric boundary layer. The meteorological experiments during the 1980 solar eclipse were conducted at Raichur, India (16°12'N, 77°21'E) located in the state of Karnataka, approximately 400-m above sea level. The main objective was to determine the changes in the earth's atmosphere during and immediately after the eclipse. The goal was to study the changes in the momentum and heat fluxes in the boundary layer due to the eclipse. Measurements were made for 2 days prior to and 1 day after the day of the eclipse to determine background characteristics of the boundary layer which might be site-dependent.

9598 (UCID—18572) Atmospheric studies in complex terrain (ASCOT) information survey. Dickerson, M.H. (ed.). (California Univ., Livermore (USA). Lawrence Livermore National Lab.). May 1980. Contract W-7405-ENG-48. 254p. (ASCOT—80-3). NTIS, PC A12/MF A01.

This document is a comprehensive, though not all-inclusive, survey of atmospheric studies in complex terrain. The work is divided into three major sections: (1) physical concepts, (2) modeling, and (3) measurements. Each section contains a brief review and discussion of subtopics accompanied by a liberal number of references. We did not attempt to draw many specific conclusions but, in some cases, noted research areas where further work is indicated. Although the ASCOT program has concentrated on noctural drainage wind studies during the past two years, the reader will find material that spans a broader aspect of atmospheric flow in complex terrain.

9599 World climate conference. Geneva, Switzerland; World Meteorological Organization (1979). 801p. (WMO—537; CONF-790258—).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

Individual papers are included in the data base with overall concern of possible anthropogenic effects on the climate. (PSB)

9600 Climatic change and human strategy. Fedorov, E.K. (State Committee for Hydrometeorology and Control of Natural Environment, Moscow, USSR). pp 15-26 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

An overview of sociological and economic impacts for climatic changes in the environment is presented. (PSB)

9601 Global ecology and man. Bolin, B. (Univ. of Stockholm, Sweden). pp 27-50 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

An overview of global geochemical cycles for nitrogen, carbon, sulfur, and oxygen is presented with biosphere and meteorological implications. (PSB)

9602 Climatic variation and variability: empirical evidence from meteorological and other sources. Hare, F.K. (Univ. of Toronto, Ontario). pp 51-87 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

This paper addresses questions of whether climate can and does change and what the present-day knowledge of climate variations and variability encompasses. (PSB)

9603 Climates of past geological epochs. Gerasimov, I.P. (Inst. of Geography, Moscow, USSR). pp 88-111 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

This paper shows how paleoclimatology can offer mankind a choice from a variety of climates of past geological epochs; however, the author feels pre-glaciation period will be the model to follow if the CO_2 concentration increase continues. (PSB)

9604 Physical basis of climate. Gates, W.L. (Oregon State Univ., Corvallis). pp 112-131 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

An overview of diagnostic and modelling research needs for climates as affected by CO_2 level is given. (PSB)

9605 Modelling of climatic changes and the problem of long-range weather forecasting. Marchuk, G.I. (Central Computing Centre, Novosibirsk, USSR). pp 132-153 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

This paper discusses problematic aspects that require further research. (PSB)

9606 Climate monitoring and climatic data collection services for determining climatic changes and variations. Izrael, Yu.A. (State Committee for Hydrometeorology and Control of Natural Environment, Moscow, USSR). pp 154-169 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

Special emphasis is given to the various characteristics of the natural environments and influencing factors required to obtain climatic data for solving the applied problems, and identifying human impacts and effects of climatic changes. (PSB)

9607 Human activities that affect climate. Munn, R.E. (Univ. of Toronto, Ontario); Machta, L. pp 170-209 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

Section I covers all human impacts excluding interference in atmospheric carbon dioxide balance. Section II deals comprehen-

sively with the many aspects of climate change related to carbon dioxide. (PSB)

9608 **Some results of climate experiments with numerical models.** Mason, B.J. (Meteorological Office, Bracknell, England). pp 210-242 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

This paper presents some important results of model simulations and tests of the sensitivity of model climates to some natural and man-made perturbations using mainly models developed at GFDL, Princeton and the UK Meteorological Office. (PSB)

9609 **Scenario of possible future climates: natural and man-made.** Flohn, H. (Univ. of Bonn, Germany). pp 243-266 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

Historical episodes of warmer and cooler climate are descried wth respect to changes in large-scale rainfall patterns. Factual examples of warmer and colder episodes are given with conclusions of risks to the current world. (PSB)

9610 **Energy and climate: a review with emphasis on global interactions.** Williams, J.; Haefele, W.; Sassin, W. (International Inst. for Applied Systems Analysis, Laxenburg, Austria). pp 267-289 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

This paper describes scenarios for the future development of energy systems, based on considerations of energy demand and the sources of supply. These scenarios provide a background against which the potential impact of energy on climate can be discussed. It emphasizes the impact on the global climate of three main energy sources (solar, nuclear, and fossil fuels), which could undergo further development on a large scale during the next fifty years. (PSB)

9611 **Climate variabiltiy and the design and operation of water resource systems.** Schaake, J.C. Jr. (National Weather Service, Silver Spring, MD); Kaczmarek, Z. pp 290-312 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

The paper briefly reviews the importance of water resources variability for regions with different hydrologic and economic conditions. Economic, institutional, and legal issues are considered. (PSB)

9612 **Climatic variability and land use: an African perspective.** Oguntoyinbo, J.S. (Univ. of Ibadan, Nigeria); Odingo, R.S. pp 552-580 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

This paper highlights events in Africa, mostly south of the Sahara within the last few hundred years, stresses the effects of climatic variability on land use patterns under varying conditions, and the resultant effects of man's impact on the environment. Emphasis is on areas marginal to the desert. (PSB)

9613 **Climatic variability and forestry.** Baumgartner, A. (Univ. of Munich, Germany). pp 581-607 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

The effects of forest management on energy, water, and biochemical balances are discussed with ecological, economic and social aspects. (PSB)

9614 **Climatic variation and marine fisheries.** Cushing, D.H. (Ministry of Agriculture, Lowestoft, England). pp 608-632 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

The author concludes that recruitments to the cod and to the sardine stock are modified by factors common to fish and tree rings; the common effect of such factors restricts the choice to be made without specifying them. (PSB)

9615 **Climatic variability, marine resources and offshore development.** Gaskell, T.F. (Oil Industry International Exploration and Production Forum, London, England). pp 633-651 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

This paper provides a survey of the activities that are being carried out in marine resource development and in the construction of ports, harbors and other coastal facilities, and ship routing in difficult climatic situations. The impact of climatic variations is often more important at the short-term weather forecasting end of the subject, but extremes of climate and long-term trends are important if catastrophes on the one hand and gross overdesign on the other are to be avoided. (PSB)

5002 Chemicals Monitoring And Transport

9616 **(AD-A—085198) High altitude pollution program stratospheric measurement system laboratory performance capability report chemical conversion techniques. Technical report, January 1978-June 1979.** Macoy, N.H.; Weingarten, R.; Pires, A.; Poultney, S.K. (Perkin-Elmer Corp., Norwalk, CT (USA). Electro-Optical Div.). Feb 1980. Contract DOT-FA77WA-4080. 214p. NTIS, PC A10/MF A01.

This report documents the laboratory measurements made to resolve specificity questions concerning the chemical conversion techniques for measurement of stratospheric trace species NO2, N2O5, and HNO3 to NO (Which is the measurable species). Particular emphasis was placed on the conversion of NO2 to NO by both catalytic and photolytic converters, thermal conversion of N2O5 and HNO3 to N02 with and without possible interfering gases, and the feasibility of measuring total odd-nitrogen concentration using catalytic thermal conversion to NO. The laboratory measurements were generally carried out at ppm concentrations at STP conditions. The GEARS/EPISODE computer code was used to model both the laboratory reactions and the behavior of the technique at stratospheric conditions. The laboratory measurement and stratospheric simulations lead to the recommendation to develop a flight prototype of a Hybrid Gas Conversion System consisting of a number of instrumentation modules. The first module would be a Total Odd-Nitrogen module (and NO) based on high temperature catalytic conversion of the odd-nitrogens and chemiluminescent detection of NO. The second module would be an NO2/NO module based on NO2 photolysis and NO chemiluminescent detection. Other modules could consist of an O3 UV photometer, and N2O gas chromatograph, and other appropriate modules that are ready at flight time.

9617 **(CONF-800264—8) Acid precipitation: the complexity of a perceived problem.** Brocksen, R.W. (Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1980. 17p. NTIS, PC A02/MF A01.

From 24. American Public Power Association annual engineering and operations workshop; Phoenix, AZ, USA (25 Feb 1980).

A brief overview of the acid precipitation problem as viewed by the Electric Power Research Institute is presented. Research programs conducted or planned by EPRI are described. (ACR)

9618 (CONF-8003115—) Carbon dioxide effects research and assessment program. Some aspects of the role of the shallow ocean in global carbon dioxide uptake. Garrels, R.M.; Mackenzie, F.T. (eds.). (Northwestern Univ., Evanston, IL (USA)). Jan 1981. Contract AC02-80EV10372. 53p. NTIS, PC A04/MF A01.

From Some aspects of the role of the shallow ocean in global carbon dioxide uptake conference; Atlanta, GA, USA (20 Mar 1980).

The purpose of the Workshop was to assess the role of the oceanic mixed layer, especially the shallow waters of shelves, seas, and estuaries, as a sink or source for atmospheric carbon dioxide. Most preceding studies have involved waters well away from shore and have not considered processes such as organic carbon production and storage in shelf sediments or in sediments of estuaries, or chemical interactions of CO_2 with carbonates in sediments or with suspended particles of the shallow ocean. Therefore, the Workshop was convened to assess the importance of such processes, and to make recommendations for further work on those aspects of CO_2 storage that seemed important in the controls of atmospheric carbon dioxide.

9619 (DOE/EV—0129) Research issues and supporting research of the National Program on Carbon Dioxide, Environment and Society, fiscal year 1980. (Department of Energy, Washington, DC (USA). Assistant Secretary for Environment). Jan 1981. 176p. NTIS, PC A09/MF A01.

This report outlines and summarizes the research conducted in the United States under the auspices of the CO_2 program. The Program encompasses six primary categories which, in turn, are divided into 18 research subcategories and 51 research issues. The research program was designed to describe the research which should be conducted regardless of institutional or even national sponsorship. Project descriptions have been collected and classified according to the research issue to which they most directly apply and have been inserted immediately following the applicable issue description. This provides, for the first time, a detailed view of the nation's effort in addressing the carbon dioxide question in FY 1980.

9620 (DOE/EV/10273—1) Acid rain information book. Draft final report. (GCA Corp., Bedford, MA (USA)). Dec 1980. Contract AC01-79EV10273. 229p. NTIS, PC A11/MF A01.

Acid rain is one of the most widely publicized environmental issues of the day. The potential consequences of increasingly widespread acid rain demand that this phenomenon be carefully evaluated. Reveiw of the literature shows a rapidly growing body of knowledge, but also reveals major gaps in understanding that need to be narrowed. This document discusses major aspects of the acid rain phenomenon, points out areas of uncertainty, and summarizes current and projected research by responsible government agencies and other concerned organizations.

9621 (DOE/MC/08087—T1) Particulate sampling in turbulent duct flows. Final report. Bajura, R.A.; Lutz, S.A.; Stenger, J.B.; Svinos, J.G.; Bekowies, P. (West Virginia Univ., Morgantown (USA)). Nov 1980. Contract AC21-77MC08087. 127p. NTIS, PC A07/MF A01.

The purpose of this research program was to identify sources of error in the measurement of gas/particulate aerosols using sampling probes. The objectives of the program included: conducting a literature review and developing an analytical model for treating the errors in sampling measurements under turbulent, anisokinetic flow conditions; performing experimental studies to determine the measurement error for particles in the respirable range; and, reviewing the status of various optical methods for in situ measurements of both particle size and concentration. A series of measurements has been completed to determine the sampling error for particles with a Stokes number of 0.02. The experimental results have led to the conclusion that an inline, or straight, sampling probe is preferable to a hooked probe of the standard type used in obtaining measurements in stacks and flues. Metal probes are shown to be preferable to the use of glass probes due to charging effects, although the glass probes provide visual information on deposition patterns in the probe body. Turbulent deposition inside the probes accounts for up to 50% of the particulate aspirated into the inlet for high rates of sampling. Up to 20% of the collected sample may be impacted on the probe tip due to turbulence. It is also shown that the deposition pattern on the filter paper used to obtain the sample is a function of the size distribution of the particulate in the aerosol. If the aerosol is highly polydisperse, a size segregation occurs on the collection filter whereby the larger diameter particles are collected on the outer edges of the filter. The size segregation of particles must be considered when examining filters to obtain information about the aerosol. Other comments on the analysis of the filters are presented in an extended appendix summarizing these experiments. (LCL)

9622 (DOE/MC/11842—T4) Investigation of acoustic aerosol agglomeration mechanisms under traveling-wave condition. Period covered: 1 July-30 September 1980. Shaw, D.T. (State Univ. of New York, Buffalo (USA)). 16 Oct 1980. Contract AC21-79MC11842. 40p. NTIS, PC A03/MF A01.

Experimental investigations of acoustically induced turbulence and shock waves in a traveling-wave tube are performed with and without the introduction of an air flow through the system. Frequency (f) and intensity (I) effects of the acoustic field are studied using a hot-film anemometer and FFT data processing unit. The effect of the acoustically induced turbulence on a laminar flow is also investigated. Sampled data are first conditioned, then processed to estimate the characteristics of turbulence. It is found that for sound pressure level >158 dB turbulence appears. Furthermore, at slightly higher level (approx. 160 dB) shock waves appear over the range of all frequency. Turbulence measurements were performed over a frequency range of 500 to 2200 Hz, with intensity over a range of 0.6 to 4.0 W/cm^2. Below I = 0.6 W/cm^2 no turbulent bursts are found. The turbulent spectrum F and the wave number k are found to satisfy a power law F proportional to k/sup α/ with α approx. = 1.7 to -2.1. The rms turbulent velocity u/sub */ is found experimentally to have an I/sup 1/2/ dependence, yet is relatively insensitive to variation of f. Throughout the whole measuring range of f and I, the rate of energy dissipation per unit mass ϵ is estimated to be 10^6 to 10^7 cm^2/s^3. It is also found that superimposing a laminar air stream through the tube will suppress the turbulence.

9623 (DP-MS—80-69) Comparison of observed mixed-layer depths to model estimates using observed temperatures and winds, and MOS forecasts. Garrett, A.J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 3p. (CONF-810306—2). NTIS, PC A02/MF A01.

From 5. symposium on turbulence, diffusion, and air pollution; Atlanta, GA, USA (9 Mar 1981).

Current operational atmospheric diffusion models use the concept of a well-mixed layer in the lower atmosphere to limit upward diffusion of pollutants. In this research, two mixed-layer prediction models were tested with selected days from the Wangara (Clarke, et al, 1971) and O'Neill (Lettau and Davidson, 1957) data sets. The models were also tested with one year (1978) of rawinsonde and surface data from four southeastern US stations. Mixed-layer depths were predicted at the four stations using observed and forecast temperatures and winds. The forecast quantities were derived from the National Weather Service Limited-area Fine Mesh (LFM) model and Model Output Statistics (MOS).

9624 (EPRI-EA—1682-SR) Rationale for quality precipitation chemistry sampling. Jansen, J.J. (Electric Power Research Inst., Palo Alto, CA (USA)). Jan 1981. 69p. NTIS, PC A04/MF A01.

The procedures used by historic and current precipitation chemistry monitoring networks differ from network to network, and they produce data that may not be comparable and may indeed be inaccurate. In order to provide good quality data sets that can be merged, it is necessary to: select sites according to strict criteria, train operators thoroughly, follow all operating procedures scrupulously to avoid contamination, have a well-written operating manual, use a central analytic laboratory, document all phases of the project, and implement a thorough quality assurance plan. This report discusses the rationale behind these principles of operation and includes a copy of the EPRI-Rockwell network operating manual and a proposed quality assurance plan.

9625 (LA-UR—81-110) Physical and chemical characteristics of Mt. St. Helens airborne debris. Sedlacek, W.A.; Heiken, G.H.; Mroz, E.J.; Gladney, E.S.; Perrin, D.R.; Leifer, R.; Fisenne, I.; Hinchliffe, L.; Chuan, R.L. (Los Alamos Scientific Lab., NM (USA); Department of Energy, New York (USA). Environmental Measurements Lab.). 1980. Contract W-7405-ENG-36. 35p. (CONF-801160—2). NTIS, PC A03/MF A01.

From Symposium and workshop on the Mount St. Helens eruption; Washington, DC, USA (18 Nov 1980).

Tephra and aerosols from the May 18, 1980 eruption of Mt. St. Helens, Washington were sampled in the lower stratosphere with a WB-57F aircraft. The main body of the plume was intercepted over western Kansas on May 20, 48 hours after the eruption, at an altitude of 15.2 km. Concentrations on filter samples were 26 ng of SO_4/g of air and 579 ng of ash/g of air. Angular glass pyroclasts ranged in size from 0.5 to 10 μm, with a mean grain size of 2 μm. Samples collected at altitudes of 16.7 and 12.5 km had only traces of SO_4 and ash. A second flight was flown, 72 hours after the eruption, on May 21. From north Texas to central Wyoming, at an altitude of 15.2 km, < 0.5 to 38 ng of ash/g of air and 1.0 to 2.2 ng of SO_4/g of air were sampled. At an altitude of 18.3 km, from central Wyoming to NW New Mexico, the plume density and character were variable. Glassy pyroclasts similar to those sampled on the first flight range in size from 0.5 to 4 μm dia. Trace element analysis revealed some volatile element enrichment, but far less than previously observed in the plume from St. Augustine Volcano, 1976. Values of $^{210}Po/^{210}Pb$ were 0.7 to 1.32 comparable to the secular equilibrium value of 1.0 and far less than ratios previously reported by Lambert.

9626 (LBL—6497) Aerosol analysis for the regional air pollution study. Final report. Jaklevic, J.M.; Gatti, R.C.; Goulding, F.S.; Loo, B.W.; Thompson, A.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1980. Contract W-7405-ENG-48. 33p. NTIS, PC A03/MF A01.

The design and operation of an aerosol sampling and analysis program implemented during the 1975 to 1977 St. Louis Regional Air Pollution Study is described. A network of ten samplers were operated at selected sites in the St. Louis area and the total mass and elemental composition of the collected particulates were determined. Sampling periods of 2 to 24 hours were employed. The samplers were capable of collecting aerosol particles in two distinct size ranges corresponding to fine (< 2.4 μm diameter) and coarse (> 2.4 μm diameter) particles. This unique feature allowed the separation of the particulate samples into two distinct fractions with differing chemical origins and health effects. The analysis methods were also newly developed for use in the St. Louis RAPS study. Total particulate mass was measured by a beta-particle attenuation method in which a precision of +- 5 μm/cm² could be obtained in a one minute measurement time. Elemental compositions of the samples were determined using an energy dispersive x-ray fluorescence method in which detectable limits of 5 ng/cm² or less were routinely achieved for elements ranging in atomic number from Al to Pb. The advantages of these analytical methods over more conventional techniques arise from the ability to automate the measurements. During the course of the two year study, a total of more than 35,000 individual samples were processed and a total of 28 concentrations measured for each sample.

9627 (LBL—11676) Soot in the atmosphere. Novakov, T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 36p. (CONF-8010135—4). NTIS, PC A03/MF A01.

From General Motors Research Laboratory conference, particulate carbon: atmospheric life cycle; Warren, MI, USA (12 Oct 1980).

The principal goal of the research described is to assess quantitatively the relative amounts of primary and secondary carbonaceous material in atmospheric aerosols and to differentiate between secondary carbonaceous species produced by photochemical and nonphotochemical reactions. The approach used most extensively involves the use of an optical attenuation technique, combined with total particulate carbon determination. The black component of soot, which is an unambiguous tracer for primary emissions, can be conveniently monitored because of its large and uniform optical absorptivity. The black carbon content of the particles can easily be determined by an optical attenuation method. Determination of total particulate carbon mass enables the study of the relations between the black and the total carbon content.

9628 (LBL—11805) Microchemical characterization of aerosols. Novakov, T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 38p. NTIS, PC A03/MF A01.

A methodology was developed to quantitate the amounts of different classes of carbonaceous aerosol particulates collected at various urban locations in the United States. The analysis of the results provides an assessment of the relative amounts of primary and secondary particulate carbon at these locations. Carbonaceous particles in the atmosphere consist of two major components - graphitic or black carbon (sometimes referred to as elemental or free carbon) and organic material. Two approaches were used in these studies. The first essentially involves a systematic study of 24-h average black carbon to total carbon ratios, since measurements of this ratio from a number of source samples give insights into the relative black to total carbon ratio of primary emissions and the source variabilities. Secondary material will not contain the black component, but it will increase the total mass of carbon and will therefore reduce the black to total carbon fraction. The second approach in the studies relies on the evolved gas (CO_2) thermal analysis method as a means of identifiying the organic and black carbon components of source emissions, source-enriched samples, and ambient particles. The differences between these should correspond to the secondary component.

9629 (ORNL/TM—7531) Plume washout from a major coal-fired power plant: a case study. Chen, N.C.J.; Saylor, R.E. (Oak Ridge National Lab., TN (USA)). Nov 1980. Contract W-7405-ENG-26. 19p. NTIS, PC A02/MF A01.

A precipitation chemistry network (~ 300 km²) consisting of 19 automatic collectors was installed around a 3200-MW coal-fired power plant located in northwest Georgia. The purpose of this study was to investigate the local plume washout from two 300-m smokestacks. Rain samples and plume directions for a single storm (December 13, 1979) were analyzed. The maximum target area deposition rates for sulfate and nitrate were found to be ~ 45% above the mean deposition rate of the control area (SO_4^{2-}, 1.23 +- 0.14; NO_3^-, 0.65 +- 0.09 nmol cm^{-2} h^{-1}). The maximum deposition rates for sulfate and nitrate were reached for a plume residence time of ~ 1 h at a site ~ 12 km SE of the power plant. Aerosol washout modeling suggested that ~ 70% of the observed excess deposition rate could be attributed to sulfate aerosol derived from the plume. However, nitrate aerosol modeling could account for only 36% of the observed excess nitrate deposition rate. The variability in rainfall intensity makes it impossible to ascribe all of the differences in sulfate and nitrate deposition to plume washout alone.

9630 (PNL—3639) Master schedule for CY-1981 Hanford environmental surveillance routine program. Blumer, P.J.; Sula, M.J.; Eddy, P.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1980. Contract AC06-76RL01830. 41p. NTIS, PC A03/MF A01.

The current schedule of data collection for the routine environmental surveillance program at the Hanford Site is provided. Questions about specific entries should be referred to the authors since modifications to the schedule are made during the year and special areas of study, usually of short duration, are not scheduled. The environmental surveillance program objectives are to evaluate the levels of radioactive and nonradioactive pollutants in the Hanford environs, as required in Manual Chapter 0513, and to monitor Hanford operations for compliance with applicable environmental criteria given in Manual Chapter 0524 and Washington State Water Quality Standards. Air quality data obtained in a separate program are also reported. The collection schedule for potable water is shown but it is not part of the routine environmental surveillance program. Schedules are presented for the following subjects: air, Columbia River, sanitary water, surface water, ground water, foodstuffs, wildlife, soil and vegetation, external radiation measurement, portable instrument surveys, and surveillance of waste disposal sites. (JGB)

9631 (UCID—18892) One-dimensional model update. Wuebbles, D.J.; Penner, J.E.; Tarp, R.L. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Jan 1981. Contract W-7405-ENG-48. 25p. NTIS, PC A02/MF A01.

Changes were made in the reaction kinetics constants for the atmospheric chemistry model. The CH_3CCl_3 emission rate was changed to 10^9 lb/y. Values for the solar flux vs wavelength were updated. Solar variability is discussed. Effects of clouds on photolysis rates are considered. (DLC)

9632 (UCRL—84352) Use of computer-simulated radiances to retrieve total atmospheric ozone data from satellite-mounted infrared multifilter radiometers. Weidhaas, P.P. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Oct 1980. Contract W-7405-ENG-48. 18p. (CONF-810305—1). NTIS, PC A02/MF A01.

From 14. annual simulation symposium; Tampa, FL, USA (16 Mar 1981).

Between March 1977 and February 1980, four satellites equipped with multichannel filter radiometer (MFR) sensors supplied infrared radiance data at various spectral channels. The Satellite Ozone Analysis Center (SOAC) at the Lawrence Livermore National Laboratory received the radiance data from the US Air Force. An ozone retrieval model was developed by SOAC in order to derive total ozone values from the radiance data. Statistical comparison against a network of ground observatories which measure total ozone with a Dobson spectrophotometer showed good agreement between MFR-derived ozone data and Dobson measurements. Thus, the scientific feasibility of SOAC's ozone retrieval model was established. Currently, SOAC has begun to automate the processing and archiving of the MFR data. Daily computer-generated contour maps of the global ozone distribution will be produced for dissemination to the scientific community. Extensive data analysis is also in progress.

9633 Coliforms in aerosols generated by a municipal solid waste recovery system. Lembke, L.L.; Kniseley, R.N. (Ames Lab., IA). Contract W-7405-ENG-82. *Applied and Environmental Microbiology (U.S.);* **40**: No. 5, 888-891(Nov 1980).

Airborne total and fecal coliform concentrations averaged 2.1×10^3 and $9.9 \times 10^2/m^3$, respectively, inside an operating solid waste recovery system. Installation of dust control equipment reduced these levels by 50%. Frequency of recovery of coliforms also dropped by 15%.

9634 Soot in urban atmospheres: determination by an optical absorption technique. Rosen, H.; Hansen, A.D.A.; Dod, R.L.; Novakov, T. (US Lawrence Berkeley Lab., CA). *Science (U.S.);* **208**: No. 4445, 741-744(16 May 1980).

Technical report: The application of a new analytical metal to determine the concentrations of particulate carbonaceous emissions (soot) in the carbonaceous aerosol load of urban atmospheres is described. The optical absorption technique is capable of determining the soot content of ambient air samples under different atmospheric conditions and over a wide geographical area. Analyses of data indicate that soot concentrations compose a major fraction of carbonaceous aerosols in the atmosphere. The carbon loadings determined in air samples collected at several U.S. locations are discussed. (6 graphs, 15 references)

9635 Calculation of the depletion of airborne pollutant plumes through dry deposition processes. Moore, R.E. (Oak Ridge National Lab., TN). *Environment International (England);* **3**: No. 1, 3-10(1980).

The depletion of airborne pollutant plumes resulting from dry deposition on ground surfaces should be taken into account when estimating pollutant concentrations in air at distances downwind from their sources. This can be done by using a reduced release rate instead of the actual release rate for the pollutant in atmospheric dispersion equations. The reduced release rate is the actual rate of release multipiled by a depletion fraction. Depletion fractions for use with the Gaussian atmospheric dispersion equation of Pasquill and Gifford were calculated by numerical integration for downwind distances ranging from 35 to 90,000 m for release heights from 1 to 400 m, and they are tabulated for convenient interpolation for intermediate values of distance and release height. Pasquill atmospheric stability categories A to G are included. The listed values are for a deposition velocity of 0.01 m/s and a wind speed of 1 m/s but can be easily converted to apply to other deposition velocities and wind speeds. The tabulated values may be applied for downwind distances close enough to the point of release that the Gaussian model may be assumed to be realistic and where the vertical dispersion of the plume has not yet been significantly affected by the overlying atmospheric lid.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 9630

9636 (AD-A—083515) Documentation and analysis of the WSEG-10 fallout prediction model. Master's thesis. Hanifen, D.W. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1980. 114p. NTIS, PC A06/MF A01.

The purpose of this independent study is to recreate and document the most popular analytical fallout model in use over the past twenty years, WSEG-10. Local access to WSEG-10 at the Air Force Institute of Technology, School of Engineering, will provide a basis for future fallout studies. As such, this study provides a fully documented Fortran computer code containing the most recent version of the WSEG-10 analytical model with sample output. To further understand this computer code, a general discussion of the WSEG-10 fallout model and analysis of crossrange dispersion (sigma (y)) and activity conservation is included. Results of the analysis of sigma(y) demonstrate that diffusive growth is not accounted for in the model and that crosswind shear is the dominant, long term effect. In a comparative conservation analysis, the WSEG model in use today does not conserve activity due to the unnormalized character of the crossrange transport function. This effect is substantial at yields less than .1 MT. Activity not conserved varied between 31.4% at 1 KT and a wind of 60 st. mi. Also included is a further discussion of model limitations or inconsistencies discovered either through computer use during this independent study or during initial literature search.

9637 (DOE/EML—389) Integrating working level monitor EML Type TF-11. Latner, N.; Watnick, S.; Graveson, R.T. (Department of Energy, New York (USA). Environmental Measurements Lab.). Jan 1981. 14p. NTIS, PC A02/MF A01.

A time-integrating working level radiation monitor is described. The purpose of the instrument is the evaluation of the alpha emission from radon and its daughter products. It has been designed to be virtually silent in operation, making it suitable for residential studies. (ACR)

9638 (EGG—1183-1765) Aerial radiological survey of the Industrial Reactor Laboratory and surrounding area Plainsboro, New Jersey. (EG and G, Inc., Las Vegas, NV (USA). Energy Measurements Group). Dec 1980. Contract AC08-76NV01183. 8p. NTIS, PC A02/MF A01.

An airborne radiological survey of a 6 km^2 area centered over the Industrial Reactor Laboratory was made 25-27 July 1979. Detected radioisotopes and their associated gamma ray exposure rates were consistent with that expected from normal background emitters, except at two locations described in this report. Count rates observed at 46 m altitude were converted to exposure rates at 1 m above the ground and are presented in the form of an isopleth map.

9639 (EML—384) Uranium mill ore dust characterization. Knuth, R.H.; George, A.C. (Department of Energy, New York (USA). Environmental Measurements Lab.). Nov 1980. 75p. NTIS, PC A04/MF A01.

Cascade impactor and general air ore dust measurements were taken in a uranium processing mill in order to characterize the airborne activity, the degree of equilibrium, the particle size distribution and the respirable fraction for the ^{238}U chain nuclides. The sampling locations were selected to limit the possibility of cross

contamination by airborne dusts originating in different process areas of the mill. The reliability of the modified impactor and measurement techniques was ascertained by duplicate sampling. The results reveal no significant deviation from secular equilibrium in both airborne and bulk ore samples for the ^{234}U and ^{230}Th nuclides. In total airborne dust measurements, the ^{226}Ra and ^{210}Pb nuclides were found to be depleted by 20 and 25%, respectively. Bulk ore samples showed depletions of 10% for the ^{226}Ra and ^{210}Pb nuclides. Impactor samples show disequilibrium of ^{226}Ra as high as +-50% for different size fractions. In these samples the ^{226}Ra ratio was generally found to increase as particle size decreased. Activity median aerodynamic diameters of the airborne dusts ranged from 5 to 30 μm with a median diameter of 11 μm. The maximum respirable fraction for the ore dusts, based on the proposed International Commission on Radiological Protection's (ICRP) definition of pulmonary deposition, was < 15% of the total airborne concentration. Ore dust parameters calculated for impactor duplicate samples were found to be in excellent agreement.

9640 **(RHO-LD—132) Rockwell Hanford Operations environmental surveillance report for calendar year 1979.** Wheeler, R.E.; Law, A.G. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jul 1980. Contract AC06-77RL01030. 97p. NTIS, PC A05/MF A01.

Environmental surveillance in the 200 Areas at Hanford and vicinity provides the necessary data to determine the overall impact of operations. Environmental data collected during 1979 show that the ambient radiation levels and the radionuclide concentration levels in uncontrolled areas, except some locations adjacent to waste handling and disposal sites and facilities, are in compliance with applicable DOE and Rockwell guidelines. A few sites adjacent to tank farms, burial grounds, and the operating facilities were found with surface contamination that exceeded guidelines and were posted as radiological controlled areas. The data also show that the ambient radiation and radionuclide concentration levels inside the 200 Areas are generally undistinguishable from background levels at the Hanford Site. Data included measurements of radionuclides in air, water, soil and sediments, vegetation, and animal feces, and measurements of external radiation. Routine radiological surveys were performed on the roadways and on the surface of the waste disposal sites.

5005 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 8563

9641 **(DP-MS—80-53) Study of effects of topography on wind rose statistics.** Pendergast, M.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 3p. (CONF-810306—3). NTIS, PC A02/MF A01.

From 5. symposium on turbulence, diffusion, and air pollution; Atlanta, GA, USA (9 Mar 1981).

Many environmental assessments are based upon meteorological calculations made with a version of the Gaussian plume model. Meteorological data are input to the model in the form of joint frequency distributions of wind direction, wind speed, and atmospheric stability. These models are used almost exclusively. This paper describes a method to adapt wind rose data from one site to another making a quantitative adjustment for differences in topography. Meteorological and topographical data from 15 meteorological towers within 200 km of the Savannah River Plant (SRP) near Aiken, SC, were used for the development and verification of the procedure.

9642 **(SAND—80-7160) Meteorological and air quality data. WIPP Site: Eddy County, New Mexico. Quarterly report, winter quarter, December 1977-February 1978.** Pocalujka, L.P.; Babij, E.; Catizone, P.A.; Church, H.W. (TRC Environmental Consultants, Wethersfield, CT (USA); Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 27p. NTIS, PC E03/MF $3.50.

Includes 7 sheets of 24 reduction microfiche.

The purpose of the WIPP meteorological, air quality, and radiological measurements program was to support the environmental effort for the evaluation of the iste suitability. This data report is the latest in a series of seasonal quarterly data summaries to be issued for the southeastern New Mexico site.

5006 Regulations

9643 **Environmental licensing of electric generating plants air requirements.** Kosky, K.F. Gainesville, FL; Environmental Science and Engineering, Inc. (1980). 46p. (NP—25216).

On August 7, 1977, the President signed into law the Clean Air Act Amendments of 1977. These amendments changed the 1970 Act and EPA regulations. Of primary importance to new electric generating plants are the requirements for PSD and revisions to NSPS for electric utility steam generating units. The discussion that follows pertains primarily to these aspects. Many states have promulgated separate and, in many cases, more stringent regulations. However, due to the large amount of material required to adequately discuss state regulations, this paper will not attempt to explain state requirements. Graphs, tabulations, and pollutant standards for aerosol particles, sulfur dioxide, carbon monoxide and photochemical oxidants are given. (PSB)

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

9644 **(ANL/AA—21) Application of diversity to regional ecological assessment: a review with recommendations.** Levenson, J.B.; Stearns, F.W. (Argonne National Lab., IL (USA)). Mar 1980. Contract W-31-109-ENG-38. 41p. NTIS, PC A03/MF A01.

Species diversity is frequently considered a primary indicator of ecosystem health, stability, and resilience. As such, species diversity is commonly the major criterion upon which environmental impact statements and ecological assessments are based. This report describes the theoretical development and refinement of the concept of ecological diversity and the various mathematical expressions of diversity. Advantages and disadvantages of each diversity expression are discussed. The application and interpretation of diversity indices for different spatial scales (e.g., specific sites and regional assessments) and variables (e.g., species diversity, habitat diversity, landscape diversity) are contrasted. Recommendations indicate the appropriate diversity indices for regional ecological assessments.

9645 **Structure and succession in the tree stratum at Lake George, New York.** Nicholson, S.A. (Univ. of the South Pacific, Suva, Fiji); Scott, J.T.; Breisch, A.R. *Ecology (U.S.);* **60**: No. 6, 1240-1254(Dec 1979).

Three species composition in 55 randomly selected stands from the south drainage basin of Lake George, New York, was analyzed by Bray-Curtis polar ordination and cluster analysis. The ordination revealed discrete groups of stand types that corresponded closely with those delineated by cluster analysis. Since the sample was unbiased, representative, and minimally distorted by the analysis, real discontinuities were presumed to exist in the vegetation. Most gaps between clusters were attributed to discontinuities in either (a) environmental factors or (b) rates of compositional change.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 9620, 9661

9646 **(DOE/EV/10298—2) Sampling designs for geochemical baseline studies in the Colorado oil shale region: a manual for practical application.** Klusman, R.W.; Ringrose, C.D.; Candito, R.J.; Zuccaro, B.; Rutherford, D.W.; Dean, W.E. (Colorado School of Mines, Golden (USA). Dept. of Chemistry and Geochemistry; Geological Survey, Denver, CO (USA)). Jun 1980. Contract AC02-79EV10298. 193p. NTIS, PC A09/MF A01.

This manual presents a rationale for sampling designs, and results of geochemical baseline studies in the Colorado portion of the oil-shale region. The program consists of a systematic trace element study of soils, stream sediments, and plants carried out in a way to be conservative of human and financial resources and yield maximum information. Extension of this approach to other parameters, other locations, and to environmental baseline studies in general is a primary objective. A baseline for any geochemical parameter can be defined as the concentration of that parameter in a given medium such as soil, the range of its concentration, and the geographic scale of variability. In air quality studies, and to a lesser extent for plants, the temporal scale of variability must also be considered. In studies of soil, the temporal variablility does not become a factor until such time that a study is deemed necessary to evaluate whether or not there have been changes in baseline levels as a result of development. The manual is divided into five major parts. The first is a suggested sampling protocol which is presented in an outline form for guiding baseline studies in this area. The second section is background information on the physical features of the area of study, trace elements of significance occurring in oil shale, and the sample media used in these studies. The third section is concerned primarily with sampling design and its application to the geochemical studies of the oil shale region. The last sections, in the form of appendices, provide actual data and illustrate in a systematic manner, the calculations performed to obtain the various summary data. The last segment of the appendices is a more academic discussion of the geochemistry of trace elements and the parameters of importance influencing their behavior in natural systems.

9647 **Anion mobility in soils: relevance to nutrient transport from forest ecosystems.** Johnson, D.W. (Oak Ridge National Lab., TN); Cole, D.W. *Environment International (England);* 3: No. 1, 79-90(1980).

Nutrient transport from forest ecosystems is strongly regulated by the availability of anions in soil solution. Each of the major anions in forest soil solutions has some unique properties which affect its production and mobility. The production of bicarbonate, one of the most strongly affected by adsorption reactions. The mobility of nitrate is regulated almost solely by biological processes, whereas chloride is relatively uninvolved in either biological or inorganic chemical reactions. Sulfate is intermediate, being involved in both biological and inorganic chemical reactions. Knowing these properties of the major anions, it is possible to assess and to predict the effects of several diverse site manipulations on soil leaching rates. Case studies from a site in Washington State consistently demonstrate the importance of accounting for bicarbonate transformations following site manipulations. Although organic anions are frequently dominant in cold-region soil solutions, very little information, on the complex factors affecting their mobilities is available. Further research into organic anion mobility and further attention to bicarbonate mobility should add greatly to the body of knowledge on nutrient transport processes in forest soils.

5103 Radioactive Materials Monitoring And Transport

9648 (DOE/EV—0128, pp 135-137) **Decontamination and decommissioning.** Jun 1980.

In Division of Environmental Control Technology Program, 1979.

Decontamination and decommissioning activities were organized into four major program areas: decontamination of surplus radioactively contaminated Department of Energy facilities; remedial action for inactive uranium mill tailings sites; Grand Junction offsite remedial action program; and remedial action at formerly utilized Manhattan Engineer District and Atomic Energy Commission contractor sites.

9649 (DOE/EV—0128, pp 139-170) **Management of surplus radioactively contaminated Department of Energy facilities.** Jun 1980.

In Division of Environmental Control Technology Program, 1979.

This section focuses on the safe management and disposition of the Department of Energy facilities that are radioactively contaminated. There are currently more than 460 of these facilities, including cribs, ponds, trenches, buildings, and reactors, more than 80 percent of which are located at Hanford, Washington. The overall plan for the management of surplus contaminated facilities owned by the Department continues to be based on the long-term objective of eliminating potential hazards and reducing the need for perpetual surveillance and maintenance. Activities within the program include (1) providing surveillance and maintenance to ensure that surplus facilities remain in an environmentally safe condition; (2) developing improved techniques for the safe and economic decontamination and disposition of radioactive facilities, equipment, materials, and land; (3) developing plans, priorities, costs, and schedules for disposition projects; and (4) implementing projects leading to improved safety, elimination of the expense of continuing surveillance and maintenance, and restoration of needed facilities or land areas without radiological restriction.

9650 (DOE/EV—0128, pp 171-180) **Remedial actions at inactive uranium mill tailings sites.** Jun 1980.

In Division of Environmental Control Technology Program, 1979.

This section discusses the program designed to eliminate or control radiological health impacts to the public from accumulations of uranium mill tailings that resulted from the milling of uranium to supply the needs of government programs. Radiological assessments of inactive uranium mill tailings sites in the United States led to the identification of 25 processing sites as candidates for remedial action. The Department of Energy is assessing the potential health effects to the public from the residual radioactive materials on or near the 25 sites.

9651 (DOE/EV—0128, pp 181-182) **Grand Junction Remedial Action Program.** Jun 1980.

In Division of Environmental Control Technology Program, 1979.

The objective of the program is to remedy conditions of potentially excessive radiation exposure to people as a result of the use of uranium mill tailings in the construction of structures at Grand Junction, Colorado. The law specifies that the Federal government shall provide 75 percent of the cost of a state-operated remedial program. Remedial action for approximately 44 percent of 800 structures estimated to be eligible under the program has been completed. It is estimated that the program can be completed by FY 1985 at an accelerated rate of about 100 structures per year.

9652 (DOE/EV—0128, pp 183-192) **Remedial actions at formerly utilized Manhattan Engineer District/Atomic Energy Commission sites.** Jun 1980.

In Division of Environmental Control Technology Program, 1979.

The objective of this program is to identify and characterize the condition of sites formerly used by the Manhattan Engineer District and the Atomic Energy Commission and, where appropriate, implement remedial action programs at sites found to have residual radioactive contamination above levels currently acceptable for unrestricted use. Full radiological surveys were performed or scheduled to be performed on 39 of those sites. Based on preliminary results, the Department of Energy currently estimates that some form of remedial action may be required for about 33 of the sites. The remedial actions that may be required range from control of a property through restricted use or decontamination of small areas, to major efforts involving the removal of contaminated soil and either decontamination or demolition of entire structures. Engineering evaluations were completed for three of these sites and were initiated at three other sites to identify options for remedial action, their estimated costs, and potential environmental impacts.

9653 **(EGG—1183-1766) Aerial radiological survey of the San Onofre Nuclear Generating Station and surrounding area, San Clemente, California.** Hilton, L.K. (EG and G, Inc., San Ramon, CA (USA). Energy Measurements Group). Dec 1980. Contract AC08-76NV01183. 14p. NTIS, PC A02/MF A01.

An airborne radiological survey of an 11 km^2 area surrounding the San Onofre Nuclear Generating Station was made 9 to 17 January 1980. Count rates observed at 60 m altitude were converted to exposure rates at 1 m above the ground and are presented in the form of an isopleth map. Detected radioisotopes and their asso-

ciated gamma ray exposure rates were consistent with that expected from normal background emitters, except directly over the plant.

9654 **(EGG—1183-1782) Aerial radiological survey of the Nuclear Fuel Services Center (NFS) and surrounding area, West Valley, New York, September 1979.** (EG and G, Inc., Las Vegas, NV (USA). Energy Measurements Group). Dec 1980. Contract AC08-76NV01183. 15p. NTIS, PC A02/MF A01.

An aerial radiological survey encompassing the Western New York Nuclear Fuel Services Center (NFS) near West Valley, New York, was conducted during 7-12 September 1979. The survey data showed that the average ground surface radiation levels for the site and its environs are less than were measured during the 1969 survey when reprocessing was occurring. The area exhibiting above-background radiation levels is decreasing with time due to (1) radioactive decay, (2) dilution and dispersion of man-made radionuclide reprocessing plant effluents produced during the period April 1966 to early 1972, and (3) the discontinuation of reprocessing operations. Excluding specific, localized NFS site facility areas, the background radiation levels for the recently surveyed area approximate the preoperational background radiation levels.

9655 **(EGG—2041) Pathways and cost-risk-benefit analyses for INEL radioactively contaminated soil areas being evaluated for decontamination and decommissioning.** Chapin, J.A. (Idaho National Engineering Lab., Idaho Falls (USA)). Dec 1980. Contract AC07-76ID01570. 116p. NTIS, PC A06/MF A01.

Several radioactively contaminated soil areas exist at the Idaho National Engineering Laboratory; virtually all are contaminated with nuclides of cesium, strontium, and cobalt at low levels of activity. This study develops a method of analysis to determine cost effective alternatives for decommissioning these areas, considering risk to the workers and general public, as well as the benefits to be gained. Because much of the input data to the analysis is highly subjective and detailed radiological characterization of the soil areas is minimal, it was decided that an analysis based on a relative weighting method be employed. The results of this analysis constitute a relative prioritization list of the soil areas being considered for decommissioning as well as the recommended decommissioning alternatives. The results of this analysis indicate that, of the 46 areas considered, 11 should be left in place under protective storage and 16 should be left as is. Nineteen areas were not analyzed because they were either operational or characterization data were not available. These results are based on a maximum exposure to a member of the general population, through realistic exposure pathways, of 5 mrem/yr.

9656 **(LA—8624-T) Measurements of uranium in soils and small mammals.** Miera, F.R. Jr. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 47p. NTIS, PC A03/MF A01.

The objective of this study was to evaluate the bioavailability of uranium to a single species of small mammal, Peromyscus maniculatus rufinus (Merriam), white-footed deer mouse, from two different source terms: a Los Alamos National Laboratory dynamic weapons testing site in north central New Mexico, where an estimated 70,000 kg of uranium have been expended over a 31-y period; and an inactive uranium mill tailings pile located in west central New Mexico near Grants, which received wastes over a 5-y period from the milling of 2.7×10^9 kg of uranium ore.

9657 **(LA—8664-PR) Environmental and radiological safety studies. Interaction of $^{238}PuO_2$ heat sources with terrestrial and aquatic environments. Progress report, July 1-September 30, 1980.** Waterbury, G.R. (comp.). (Los Alamos Scientific Lab., NM (USA)). Jan 1981. Contract W-7405-ENG-36. 45p. NTIS, PC A03/MF A01.

The containers for $^{238}PuO_2$ heat sources in radioisotope thermoelectric generators are designed with large safety factors to ensure that they will withstand reentry from orbit and impact with the earth and safely contain the nuclear fuel until it is recovered. Existing designs have proved more than adequately safe, but the Space and Terrestrial Division of the Department of Energy Office of Advanced Nuclear Systems and Projects continually seeks more information about the heat sources to improve their safety. The work discussed here includes studies of the effects on the heat source of terrestrial and aquatic environments to obtain data for design of even safer systems. The data obtained in several ongoing experiments are presented; these data tables will be updated quarterly. Discussions of experimental details are minimized and largely repetitive in succeeding reports. Compilations of usable data generated in each experiment are emphasized. These compilations include data from environmental chamber experiments that simulate terrestrial conditions, experiments to measure PuO_2 dissolution rates, soil column experiments to measure sorption of plutonium by soils, and several aquatic experiments.

9658 **(PNL-SA—8268) Discrepancies in estimates of plutonium levels in soils by different analytical methodologies.** Kinnison, R.R.; Gilbert, R.O. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract AC06-76RL01830. 8p. (CONF-800157—2). NTIS, PC A02/MF A01.

From Nevada applied ecology group (NAEG) information meeting; Las Vegas, NV, USA (29 Jan 1980).

A statistically significant discrepancy was found in estimates of plutonium concentrations in a data set of 23 samples where plutonium has been estimated by both Pu/Am ratios and by direct plutonium analysis. Plutonium concentrations derived from Pu/Am ratios average 13% higher than concentrations obtained from chemical analysis. A possible explanation is a change in ^{241}Am Ge(Li) methodology between the two relevant data sets.

9659 **(SAND—80-1064) Sorption coefficients for radionuclides on samples from the water-bearing Magenta and Culebra members of the Rustler Formation.** Lynch, A.W.; Dosch, R.G. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 23p. NTIS, PC A02/MF A01.

The sorbing characteristics of samples from the Magenta and Culebra dolomites of the Rustler Formation (which overlie the proposed site for the Waste Isolation Pilot Plant (WIPP) in southeastern New Mexico) for various radionuclides have been studied. Core samples extracted from various depths and boreholes within a given formation were selected to provide a cross section of materials which are present in the formations. They varied in composition from pure dolomite to nearly pure anhydrite. The radionuclides used in the sorption coefficient measurements (isotopes of Cs, Sr, Tc, Eu, Am and Pu) were dissolved in a simulated Culebra groundwater at concentrations of 0.1 μCi/ml or less. The results indicate that the sorption coefficients (Kd's) of these water-bearing units may vary widely depending on the borehole area and over several feet in depth in a common borehole. Cesium Kd values from 0.6 to 218 ml/g and 1.2 to 68 on Magenta and Culebra samples, respectively. Strontium Kd values ranged from 1.1 to 30 on Magenta Samples and from 0.6 to 32 on Culebra samples. Variations of Eu, Pu and Am Kd's were generally less than an order of magnitude on both Culebra and Magenta samples. Technetium was not sorbed by any of the samples. With few exceptions, samples with high dolomite contents had higher sorption coefficients than those with high anhydrite concentrations. Clay content may also be a factor for some radionuclides, particularly Cs, which has been shown to sorb preferentially on clay particles in Magenta.

9660 **Proceedings of the workshop on the use of argillaceous materials for the isolation of radioactive waste.** Paris, France; OECD (1980). vp. (CONF-790938—).

From Workshop on the use of argillaceous materials for the isolation of radioactive wastes; Paris, France (10 Sep 1979).

Items within the scope of EDB are entered individually. (ACR)

9661 **Microbial activity of trench leachates from shallow-land, low-level radioactive waste disposal sites.** Francis, A.J.; Dobbs, S.; Nine, B.J. (Brookhaven National Lab., Upton, NY). *Applied and Environmental Microbiology (U.S.);* **40**: No. 1, 108-113(Jul 1980).

Trench leachate samples collected anoxically from shallow-land, low-level radioactive waste disposal sites were analyzed for

total aerobic and anaerobic populations, sulfate reducers, denitrifiers, and methanogens. Among the several aerobic and anaerobic bacteria isolated, only Bacillus sp., Pseudomonas sp., Citrobacter sp., and Clostridium sp. were identified. Mixed bacterial cultures isolated from the trench leachates were able to grow anaerobically in trench leachates, which indicates that the radionuclides and organic chemicals present were not toxic to these bacteria. Changes in concentrations of several of the organic constituents of the waste leachate samples were observed due to anaerobic microbial activity. Growth of a mixed culture of trench-water bacteria in media containing a mixture of radionuclides, ^{60}Co, ^{85}Sr, and ^{134} ^{137}Cs, was not affected at total activity concentrations of 2.6 x 10^2 and 2.7 x 10^3 pCi/ml.

9662 Plutonium inventories in two old-field ecosystems in8the vicinity of a nuclear-fuel reprocessing facility. Pinder, J.E. III (Savannah River Ecology Lab., Aiken, SC); Smith, M.H.; Boni, A.L.; Corey, J.C. Horton, J.H. (Savannah River Ecology Lab., Aiken, SC). Contract AT(07-2)-1;EY-76-C-09-0819. *Ecology (U.S.);* **60**: No. 6, 1141-1150(Dec 1979).

Plutonium inventories were determined in two old-field ecosystems, Fields 1 and 2, located near a nuclear-fuel reprocessing facility that had released approximately 640 mCi (24 GBq) ^{238}Pu and 570 mCi (21 GBq) $^{239\ 240}Pu$ to the atmosphere in the 20 yr preceding sampling. Field 1 was 230 m from the point of release (a 62-m stack) and contained 57 nCi (2.1 kBq) $^{238}Pu/m^2$ and 255 nCi (9.4 kBq) $^{239\ 240}Pu/m^2$. Field 2 was 420 m from the stack and contained 15 nCi (0.56 kBq) $^{238}Pu/m^2$ and 79 nCi (2.9 kBq) $^{239\ 240}Pu/m^2$. The distribution of Pu between soil and vegetation components was similar in the two fields with only 1.3% of the ^{238}Pu and 0.2% of the $^{239\ 240}Pu$ occurring in pines, herbaceous vegetation and litter. More of the Pu could be suspended from the soil into the atmosphere by a 6 m/s wind on Field 1 than on Field 2 due to the lower biomass of herbaceous vegetation and litter on Field 1. Approximately 2% of the ^{238}Pu and 0.5% of the $^{239\ 240}Pu$ could be resuspended on Field 1, whereas only 0.5% of the ^{238}Pu and 0.1% of the $^{239\ 240}Pu$ could be resuspended on Field 2. Plutonium contamination of the vegetation occurred primarily by (1) direct deposition of recently released Pu onto vegetation, and (2) resuspension of Pu from the soil to vegetation surfaces. Root uptake apparently made negligble contributions to the Pu contents of above-ground vegetation.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 8563, 8594, 8666, 8834, 9754, 9767, 9778, 9780

9663 (COO—2758-7) Strip mine reclamation: criteria and methods for measurement of revegetation success. Progress report, April 1, 1980-March 31, 1981. Carrel, J.E.; Kucera, C.L.; Johannsen, C.J.; Blanchar, R.W. (Missouri Univ., Columbia (USA)). Dec 1980. Contract AS02-76EV02758. 75p. NTIS, PC A04/MF A01.

During this contract period research was continued at finding suitable methods and criteria for determining the success of revegetation in Midwestern prime ag lands strip mined for coal. Particularly important to the experimental design was the concept of reference areas, which were nearby fields from which the performance standards for reclaimed areas were derived. Direct and remote sensing techniques for measuring plant ground cover, production, and species composition were tested. 15 mine sites were worked in which were permitted under interim permanent surface mine regulations and in 4 adjoining reference sites. Studies at 9 prelaw sites were continued. All sites were either in Missouri or Illinois. Data gathered in the 1980 growing season showed that 13 unmanaged or young mineland pastures generally had lower average ground cover and production than 2 reference pastures. In contrast, yields at approximately 40% of 11 recently reclaimed mine sites planted with winter wheat, soybeans, or milo were statistically similar to 3 reference values. Digital computer image analysis of color infrared aerial photographs, when compared to ground level measurements, was a fast, accurate, and inexpensive way to determine plant ground cover and areas. But the remote sensing approach was inferior to standard surface methods for detailing plant species abundance and composition.

9664 (DOE/EV/70003—12) Establishment, succession, and stability of vegetation on surface mined lands in eastern Montana. Annual progress report. Sindelar, B.W.; Plantenberg, P.L. (Montana State Univ., Bozeman (USA). Dept. of Animal and Range Sciences). 1 Jul 1980. Contract AT06-76EV70003. 27p. NTIS, PC A03/MF A01.

An ecological investigation of reclamation and plant succession on surface mined land near Colstrip, Montana, was initiated in June 1975. Its purpose was to examine and document development, stability, and permanence of plant communities established on semiarid mined land since 1928. This report includes analyses of data collected through four growing seasons on study sites located on naturally revegetated spoil and on seeded spoil. Sites included revegetated spoil seeded in 1969, 1970, 1971, 1972, 1973, 1975, and 1977. Naturally revegetated spoil was mined in 1928 and 1930. Data collected include plant density, frequency, cover, yield, composition, species diversity, and soil moisture content. Previous progress reports have detailed successional changes and patterns observed. Analyses of causal factors are included. This report summarizes successional changes which occurred during the past year, presents updated analyses of successional trends and patterns, and presents additional conclusions derived from these analyses.

9665 Significance of various soil amendments to borrow pit reclamation with loblolly pine and fescue. Berry, C.R.; Marx, D.H. (Inst. for Mycorrhizal Research and Development, Athens, GA). Contract A109-76-SRO-870. *Reclamation Review (U.S.);* **3**: No. 2, 87-94(1980).

Loblolly pine seedlings with ectomycorrhizae formed by Pisolithus tinctorius (Pt) or naturally occurring Thelephora terrestris (Tt) were planted on a borrow pit in South Carolina in plots with no amendment; with fertilizer plus dolomitic limestone alone and with pine bark or bottom ash or bark and ash together; or with dried sewage sludge alone and with bark or ash or bark and ash together. All plots were subsoiled, disked, and seeded to fescue grass before planting pine seedlings. Naturally occurring Pt formed abundant ectomycorrhizae on all Tt seedlings by the end of the first season, precluding any specific ectomycorrhizal fungus effect for the duration of the study. Sewage sludge alone or with bark or ash amendments dramatically improved pine seedling growth and grass biomass in comparison with other soil treatments. Mean seedling volume (D^2H) was 28 times greater and grass biomass was five times greater in the sludge plots than on nonsludge plots. Generally, soil amended with sludge contained more N, P, organic matter, and had a higher cation exchange capacity than soil of other treatments. Foliage of pine seedlings in sludge-amended soil also contained more N and less Ca than other seedlings. The significance of these results to reclamation of borrow pits is discussed.

9666 Growth of containerized loblolly pine with specific ectomycorrhizae after 2 years on an amended borrow pit. Ruehle, J.L. (Inst. for Mycorrhizal Research and Development, Athens, GA). *Reclamation Review (U.S.);* **3**: No. 2, 95-101(1980).

A borrow pit with exposed subsoil in South Carolina was graded level and deep subsoiled. Plots were amended with processed sewage sludge or commercial fertilizer followed by a seeding with fescue. Container-grown loblolly pines colonized with Pisolithus tinctorius, Thelephora terrestris, or no ectomycorrhizae were planted by hand on the plots one year after site preparation. Two years after planting on sludge-amended plots, seedlings initially colonized with Pisolithus had greater height, root-collar diameter, and seedling volume (D^2H) than Thelephora or control seedlings. The means for these three growth parameters on seedlings planted on fertilized plots were no different between Pisolithus and Thelephora seedlings, but Pisolithus seedlings were greater than controls. There was no difference in survival among mycorrhizal treatments on the sludge plots. Survival and seedling volume were integrated into plot volume indices (PVI). Seedlings on sludge plots had greater PVI than seedlings on fertilized plots. Pisolithus seedlings on sludge plots had 265 and 528% greater PVI after two years than Thelephora or control seedlings. Containerized loblolly seedlings tailored with Pisolithus can be successfully established and rapid growth obtained on a subsoiled borrow pit amended with sewage sludge. This procedure may be applicable to thousands of acres of similar borrow pits left by highway and construction work.

9667 **Cost-benefit analysis of reclaiming abandoned gob and slurry: west central Illinois.** Bernard, J.R. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *Reclamation Review (U.S.);* **3**: No. 2, 103-111(1980).

Reclamation of abandoned gob and slurry areas associated with underground coal mining operations has economic impacts which are only partly understood at this time. In Illinois, such an area was chosen for reclamation demonstration and research. Costs and regional benefits of the project are compared here in constant dollars for a fifty-year expected project life. Two methods of accounting for aesthetic benefits are used, i.e., the land value method and the willingness to pay method. Benefits range from $340,000 to $430,000 using the land value method and $570,000 to $860,000 using the results of a willingness to pay survey. Costs of reclaiming the site, including maintenance and installation of recreation facilities on the site, are expected to total about $705,000. Cost-benefit analysis of proposed reclamation projects will help states in the selection of abandoned sites for reclamation where economic benefit is of major importance.

9668 **Climatic change and the exploitation of climatic resources in China.** Chia-cheng, C. (Academy of Meteorological Science of Central Meteorological Service, Peking, China); Shao-wu, W.; Szu-chung, C. pp 510-524 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

The paper briefly presents results of recent studies on climate changes in China with remarks on the problem of exploitation of climatic resources. (PSB)

9669 **Renewable resources and agriculture in Latin America in relation to the stability of climate.** Burgos, J.J. (Univ. of Buenos Aires, Argentina). pp 525-551 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

The idea of climate as a renewable resource is presented with the suggestion of economic planning for human values. (PSB)

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 8901, 9614, 9615, 9644, 9680

9670 **(ANL/EES-TM—96(Vol.1)) Energy optimization of water and wastewater management for municipal and industrial applications conference.** (Argonne National Lab., IL (USA)). Aug 1980. Contract W-31-109-ENG-38. 570p. (CONF-791237—(Vol.1)). NTIS, PC A24/MF A01.

From 12. IECEC conference on energy conservation in the treatment of industrial wastewaters; New Orleans, LA, USA (10 Dec 1979).

These proceedings document the presentations given at the Energy Optimization of Water and Wastewater Management for Municipal and Industrial Applications, Conference, sponsored by the Department of Energy (DOE). The conference was organized and coordinated by Argonne National Laboratory. The conference focused on energy use on conservation in water and wastewater. The General Session also reflects DOE's commitment to the support and development of waste and wastewater systems that are environmentally acceptable. The conference proceedings are divided into two volumes. Volume 1 contains the General Session and Sessions 1 to 5. Volume 2 covers Sessions 6 to 12. Separate abstracts are prepared for each item within the scope of the Energy Data Base.

9671 **(DOE/EV/10154—T1) Conceptual design of a regional water quality screening model.** Davis, M.J. (Argonne National Lab., IL (USA)). Jan 1981. Contract AC02-80EV10154. 56p. NTIS, PC A04/MF A01.

This water quality assessment methodology is intended to predict concentrations at future times and to estimate the impacts on water quality of energy-related activities (including industrial boilers). Estimates of impacts on water quality at future times are based on incremental changes in pollutant inputs to the body water. Important features of the model are: use of measured concentrations to account for existing conditions; consideration of incremental changes in pollutant loads; emphasis on the energy sector and industrial boilers; analysis restricted to streams only; no attempt to fully account for pollutant behavior; and flexible design, so that future improvements can be incorporated. The basic approach is very similar to the one used by Argonne's ARQUAL model but will allow more complex pollutant behavior and more flexibility in use. (PSB)

9672 **Nitrate and ammonium uptake in Antarctic waters.** Olson, R.J. (Univ. of California, San Diego). Contract AC03-79EV70020. *Limnology and Oceanography (U.S.);* **25**: No. 6, 1064-1074(Nov 1980).

Nitrate and ammonium uptake rates were measured by the ^{15}N tracer technique in Antarctic waters. The ratio $f = NO_3^-$ uptake/NO_3^- uptake + NH_4^+ uptake averaged 0.54 in the Scotia Sea in early spring and 0.40 in the Ross Sea in summer, indicating that NO_3^- and NH_4^+ contribute about equally to primary production in these regions and that a large proportion of the primary production is exported from the surface layers. Uptake rates in laboratory experiments increased with increasing temperature and the relative uptake of NH_4^+ was positively correlated with increasing mean ambient NH_4^+ concentration and depth in the water column.

5202 Chemicals Monitoring And Transport

9673 **(DOE/ER/03040—T1) X-ray fluorescence analysis study. Final report, December 1, 1970-December 31, 1977.** Kneip, T.J.; Laurer, G.R. (New York Univ., NY (USA). Inst. of Environmental Medicine). 1978. Contract AS02-76EV03040. 236p. NTIS, PC A11/MF A01.

This report has described the most significant experiments and the results obtained, during the development of a system for the detection and measurement of Pb in blood using radioisotope-excited x-ray fluorescence analysis, over the contract period. Briefly, the report described: detector selection; source selection; source-sample-detector geometry; sample preparation; system calibration; and separation technique. (PSB)

9674 **(DOE/EV/03201—T2) Water assessment report: Section 13 (c); Great Plains gasification project, Mercer County, ND.** (Water Resources Council, Washington, DC (USA)). Dec 1980. Contract AI01-76EV03201. 47p. NTIS, PC A03/MF A01.

The Water Resources Council is completing a water assessment of synfuels development in the Upper Missouri River Basin. This is being done under Section 13(a) of the Federal Nonnuclear Energy Research and Development Act. The assessment area includes the coal deposits in the Mercer County project site. Levels of North Dakota coal gasification development that are several times the production level of the Great Plains gasification project are being examined. This report assesses: (1) the availability of adequate water supplies to meet the water requirements of the project, supporting activities, and other development induced by the project; and (2) the changes in the water resources that will result from the project. Findings of the 13(a) assessment show that water supplies are physically available within the mainstem of the Missouri River in North Dakota to supply the requirements of the gasification facilities and the supporting activities - mining and reclamation, electricity, and project-induced population increases.

9675 **(EPRI-CS—1629) Biofouling control with ozone at the Bergen Generating Station.** Sugam, R.; Guerra, C.R.; DelMonaco, J.L.; Singletary, J.H.; Sandvik, W.A. (Public Service Electric and Gas Co., Newark, NJ (USA)). Nov 1980. 143p. NTIS, PC A07/MF A01.

The results of a study designed to evaluate the effectiveness of ozone as an alternative to chlorine for condenser biofouling control in a once-through cooling system are reported. Tests were con-

ducted at PSE and G's Bergen Generating Station using a pilot-scale condenser system to simulate plant condenser operations. Three model condensers were operated under identical conditions with only the biocide treatment differing. Comparisons of ozone and chlorine were made and the minimum effective levels of each were determined by daily measurements of the heat transfer coefficient across the model condenser tubes and/or the water side pressure drop. Final evaluation was based on the mass of biofouling material collected from the tubewalls. Test results indicate that chlorine is capable of effective biofouling control when applied for 2 hours/day at a level as low as 0.1 mg/l. Ozone, applied on the same schedule, requires 0.5 mg/l for effective control. The results of this study are representative of only the Bergen site. Water quality at each particular site will influence the development of the biofouling organisms, the chemical reactions of the biocides, and therefore, the effectiveness of the treatment methodology. The results suggest that further examination of ozonation for biofouling control is warranted. Although much more costly than chlorine, its effects on indigenous ecosystems may prove ozone to be better suited for application at selected power plants. It must be emphasized, however, that much more information is necessary before ozone can be recommended as an environmentally acceptable alternative to chlorine.

9676 **Effectiveness of submersed angiosperm-epiphyte complexes on exchange of nutrients and organic carbon in littoral systems. III. Refractory organic carbon.** Mickle, A.M.; Wetzel, R.G. (Michigan State Univ., Hickory Corners). Contract EY-76-S-02-1599. *Aquatic Botany (Netherlands);* **6**: vp(1979).

Refractory dissolved organic compounds, consisting mainly of fulvic acids labelled with ^{14}C of aquatic plant origin, were added to the inlet stream water of a hardwater lake and passed through two continuously, very slowly flowing (3 1/24 h) littoral systems. System I contained a natural stand of Scripus subterminalis Torr. and System II contained Myriophyllum heterophyllum Michx. Macrophytic epiphytes were left intact. Control systems, containing similar sediments without macrophytes, received identical treatments. Dissolved organic carbon (DOC), both labelled and unlabelled, of inflow and outflow water was fractionated into several molecular weight fractions; uv absorption and fluorescence of dissolved organic matter, particulate organic carbon (POC), and major cationic concentrations were also analyzed in inflowing and outflowing water. The pathways of the labelled refractory organic carbon amendments were followed in the water, the plant foliage and roots, epiphytes, and the sediments.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 8679, 9630, 9640, 9657, 9729

9677 **(COO—2529-13) Plutonium, cesium and uranium series radionuclides in the Hudson River estuary and other environments. Annual technical progress report, December 1, 1979-November 30, 1980.** Simpson, H.J.; Trier, R.M.; Olsen, C.R. (Columbia Univ., Palisades, NY (USA). Lamont-Doherty Geological Observatory). 1980. Contract AS02-76EV12529. 197p. NTIS, PC A09/MF A01.

Radionuclide activities were measured in a large number of sediment cores and suspended particle samples throughout the salinity range of the Hudson River estuary. Activities of ^{137}Cs, ^{134}Cs and ^{60}Co determined by gamma spectrometry and $^{239\ 240}Pu$ and ^{238}Pu determined by alpha spectrometry indicate reasonably rapid accumulation rates in the sediments of marginal cove areas, and very rapid deposition in the harbor region adjacent to New York City, resulting in $^{239\ 240}Pu$ accumulations there more than an order of magnitude greater than the fallout delivery rate. Measurable amounts of reactor-derived ^{134}Cs and ^{60}Co are found in nearly al sediment samples containing appreciable ^{137}Cs between 15 km upstream of Indian Point and the downstream extent of our sampling about 70 km south of the reactor. Fallout $^{239\ 240}Pu$ reaching the Hudson appears to be almost completely retained within the systems by particle deposition, while 70 to 90% of the ^{137}Cs derived from both reactor releases and fallout has been exported to the coastal waters in solution. Activity levels of $^{239\ 240}Pu$ in New York harbor sediments indicate a significant source in addition to suspended particles carried down the Hudson. The most likely cause appears to be transport into the estuary of particles from offshore waters having higher specific activities of $^{239\ 240}Pu$. Measurements of fallout $^{239\ 240}Pu$ in a saline lake with a high carbonate ion concentration yielded water column activities about two orders of magnitude greater than has been found for fallout plutonium in other continental waters, indicating extensive mobility in some natural water environments. Experiments using lake water suggest that carbonate ion may indeed be a critical factor in regulating plutonium solubility and that low molecular weight complexes are primarily responsible for enhanced plutonium solubility.

9678 **(LA—8006-MS) Uranium hydrogeochemical and stream sediment reconnaissance of the Dixon Entrance NTMS and Prince Rupert D-6 quadrangles, Alaska, including concentrations of forty-two additional elements.** Warren, R.G.; Hensley, W.K.; Hanks, D.E. (Los Alamos Scientific Lab., NM (USA)). Sep 1980. Contract W-7405-ENG-36. 193p. NTIS, PC A09/MF A01.

During August 1978, sediment and water samples were collected from 203 lakes, streams, and springs in the Dixon Entrance and Prince Rupert D-6 quadrangles, Alaska. All resulting 950 sediment samples were analyzed for uranium and 42 additional elements. Due to their low uranium concentrations, analytical results (uranium only) are presented without discussion for water samples. Variations in concentrations of all 43 elements among the five sieve fractions at each location are generally less than analytical uncertainty. Therefore, elemental analyses are generally comparable for a wide range in sieve fractions for sediment sample locations in southeastern Alaska. However, at some few locations, several elemental concentrations increase with finer mesh size; for uranium, such an increase may be associated with mineralization. Waterborne sediment samples collected from the center of a stream yield analyses essentially identical to those collected from the adjacent bank for most elements. At a few locations, concentrations of the ferrous elements, particularly manganese and cobalt, differ notably between the stream center and bank; such behavior is characteristic of mineralized areas. Concentrations of the ferrous elements, particularly manganese and cobalt, are strikingly enriched in the stream sediments compared either to lake sediments or to crustal abundances. This suggests that this area might be a favorable location for strategic resources of these elements. Uranium concentrations in all 950 sediment samples of all sieve fractions range 0.54 to 22.80 ppM, with a median of 2.70 ppM. A consideration of those sediment samples that exhibit high uranium concentrations and a multielement factor analysis were equally successful in defining the Bokan Mountain uranium deposit. Both methods of data evaluation defined three areas that are geochemically similar to the Bokan Mountain area within the quadrangle.

9679 **Distribution of mercury, Cesium-137, and plutonium in an intermittent stream at Los Alamos.** Hakonson, T.E. (Los Alamos Scientific Lab., NM); White, G.C.; Gladney, E.S.; Dreicer, M. Contract W-7405-ENG-36. *Journal of Environmental Quality (U.S.);* **9**: No. 2, 289-292(Jun 1980).

The results of a study on the distribution of Hg, ^{137}Cs, ^{238}Pu, and $^{239\ 240}Pu$ in channel sediments and adjacent bank soils in an intermittent stream used for treated liquid effluent disposal since 1963 are summarized. Concentrations of the three radionuclides and Hg in stream bank soils were comparable to adjacent channel sediments demonstrating that the stream bank serves as a deposition site for chemicals released to the channel. This finding has important implications on the long-term behavior of effluent contaminants since other studies at Los Alamos have shown that the vegetated stream banks retard downstream movement of chemicals bound to soils and provide a pathway for transport of these materials to biota. Concentrations of the radionuclides and mercury were more uniformly distributed with distance and depth in the channel sediments than in the bank soils. The action of periodic surface water in the channel partially explains those differences. Statistical analysis of the data revealed that 50 to 85% of the variability in contaminant concentrations in bank and channel locations was due to variation with distance while depth contributed relatively little to variability.

5204 Thermal Effluents Monitoring And Transport

9680 (DOE/EV/10004—02) Thermal-nutritional regulation of functional groups in running water ecosystems. Technical progress report, October 1, 1978-November 1, 1980. Cummins, K.W. (Oregon State Univ., Corvallis (USA). Dept. of Fisheries and Wildlife). 1 Nov 1980. Contract AT06-79EV10004. 79p. NTIS, PC A05/MF A01.

The research encompassed three general areas: (1) characterization of stream macroinvertebrate functional feeding groups (shredders, collectors, scrapers, and predators) based on morphological and behavioral adaptations and food-source-specific growth responses of selected species; (2) demonstration of the relative importance of temperature and food quality (in which maximum quality is defined as that producing the most growth) in controlling growth rate and survivorship of stream functional groups; and (3) derivation and refinement of conceptual and quantitative models of stream ecosystem structure and function, with particular emphasis on detrital processing. Verification of the functional group concept as a tool for assessing and predicting is reflected in alterations of the relative dominance of various functional groups. Food quality can strongly influence the growth rates of shredders, collectors and scrapers and override the effects of temperature in a number of cases. Gathering collectors may select food particles by size (or at least be restricted to a limited portion of the total range available) but representative species do not appear to select for quality.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 8563, 8590, 8897, 8898, 8899, 8900, 9196

9681 (USGS-OFR—80-683) Hydrologic assessment, Eastern Coal Province, Area 23, Alabama: Black Warrior River; Buttahatchee River; Cahaba River; Sipsey River. Harkins, J.R. (Geological Survey, University, AL (USA)). Jun 1980. 107p. Geological Survey, University, AL.

Area 23 is located at the southern end of the Eastern Coal Province, in the Mobile River basin, includes the Warrior, Cahaba, and edges of the Plateau coal fields in Alabama, and covers an area of 4716 square miles. This report is designed to be useful to mine owners and operators and consulting engineers by presenting information about existing hydrologic conditions and identification of sources of hydrologic information. General hydrologic information is presented in a brief text and illustrations on a single water-resources related topic. Area 23 is underlain by the Coker and Pottsville Formations and the pre-Pennsylvanian rocks. Area 23 has a moist temperate climate with an annual average rainfall of 54 inches and the majority of the area is covered by forest. The soils have a high erosion potential when the vegetative cover is removed. Use of water is primarily from surface-water sources as ground-water supplies generally are not sufficient for public supplies. The US Geological Survey operates a network of hydrologic data collection stations to monitor the streamflow and groundwater conditions. This network includes data for 180 surface-water stations and 49 ground-water observation wells. These data include rate of flow, water levels, and water-quality parameters. Hydrologic problems relating to surface mining are (1) erosion and sedimentation, (2) decline in ground-water levels, and (3) degradation of water quality. Decline in ground-water levels can occur in and near surface-mining areas when excavation extends below the static water level in the aquifer. This can cause nearby wells and springs to go dry. Acid mine drainage is a problem only adjacent to the mined area.

5206 Regulations

9682 Hazardous chemicals under the Federal Water Pollution Control Act. Hearings before the Subcommittee on Water Resources of the Committee on Public Works and Transportation, House of Representatives, Ninety-Sixth Congress, Second Session, April 15, 16, and 17, 1980. Washington, DC; Committee on Public Works and Transportation (1980). 388p. GPO.

Hearings were held to include hazardous chemicals in the FWPCA in relation to liability and compensation for release of oil, hazardous substances and hazardous wastes. Funding of emergency assistance authorities is also covered. Fundamental technical, environmental, economic, legal and sociopolitical concerns are addressed. (PSB)

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 8896

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 8743, 9184, 9186, 9187, 9189, 9190, 9599, 9607, 9611, 9613, 9619, 9744

9683 Global aspects of food production. Swaminathan, M.S. (Indian Council of Agricultural Research, New Delhi). pp 369-405 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

This paper analyzes the current food situation, trends in demand and supply, factors responsible for the food supply instability and the the steps seen as necessary to achieve the World Food Conferences goal. (PSB)

9684 Climate and economic activity. d'Arge, R.C. (Univ. of Wyoming, Laramie). pp 652-681 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

This paper reviews and summarizes evidence on the impact of climatic changes on various economic sectors of some nations. (PSB)

9685 Climate and society: lessons from recent events. Kates, R.W. (Clark Univ., Worcester, MA). pp 682-691 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

This paper views the subject from extreme weather events, such as, blizzards, droughts, floods, tropical cyclones, tornadoes and storms; then it considers the long-term human response. (PSB)

5302 Assessment Of Energy Technologies

9686 (DOE/EV—0128) Division of Environmental Control Technology Program, 1979. (Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology). Jun 1980. 161p. NTIS, PC A08/MF A01.

Separate abstracts were prepared for the 10 sections in this progress report dealing with environmental engineering. (KRM)

5303 Environmental Impact Statements

REFER ALSO TO CITATION(S) 8563, 8590

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

REFER ALSO TO CITATION(S) 9741, 9743

9687 Phenologic influences on cohort-specific reproductive strategies in mice (Peromyscus polionotus). Dapson, R.W. (Univ of Michigan, Flint). Contract AT(38-1)-310;AT(38-1)-708. *Ecology (U.S.);* **60**: No. 6, 1125-1131(Dec 1979).

Breeding seasons and birth cohorts were defined for two populations of mice (Peromyscus polionotus). Cohort-specific differences in reproductive effort were correlated with residual reproductive value. In one population, mice lived nearly 2 y, reproduced at moderate rates, and showed few differences in cohort-specific reproductive strategy. Mice from the other population lived < 1 y, and spring-, summer-, and fall-born females exhibited markedly different reproductive strategies. Cohorts able to breed in a future season had moderate reproductive efforts, which did not increase risk of mortality. Extraordinary efforts (being pregnant and lactating simultaneously), which seriously increased mortality rate, were undertaken when residual reproductive value became zero. Nestling mortality increased with litter size when there were more than three young per litter, but larger litters still resulted in more weaned young than did smaller litters. These observations provide additional confirmation of the model of Pianka and Parker (1975). It is possible that populations of very short-lived mammals characteristically have seasonal cohorts operating under different reproductive strategies.

5502 Biochemistry

9688 (BNL—28684) Cycles and Q-cycles in plant photosynthesis. Crowther, D.; Hind, G. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 20p. (CONF-8010149—1). NTIS, PC A02/MF A01.

From Function of quinones in energy conserving systems conference; Hanover, NH, USA (26 Oct 1980).

The classical description of electron transfer in chloroplasts linked photosystem II to photosystem I with a simple hydrogen-carrying plastoquinone shuttle which transferred one H^+ per electron travelling through the chain. An additional H^+/e^- liberated inside the thylakoid with the splitting of water provided an overall H^+/e^- stoichiometry of 2. Cyclic electron transfer around photosystem I via cytochrome b_{563} was considered to reenter the main chain at plastoquinone, translocating one H^+ per electron completing the cycle. Such a scheme has had to be modified, however, following the discovery of a further charge translocation that is observed, following a single turnover flash, as a slow rise in the electric-field indicating bandshift termed P518. According to the earlier scheme for electron transfer in chloroplasts, charge separation across the thylakoid membrane took place only in the reaction centers of photosystems I and II, giving a rapid (submicrosecond) appearance of the P518 bandshift. In the last few years, however, several groups have shown a slow (millisecond) additional component of the P518 rise following sngle turnover flash illumination of algae or chloroplasts. The maximum amplitude of this slow component is equal to that of the fast phase generated by electron transfer in photosystem I reaction centers, and its appearance is dependent on the redox poise of the electron transfer chain. If this field-indicating slow rise in P518 (P518/sub s/) reflects an electron crossing the thylakoid membrane from inside to out if a dark step, then additional complexities must exist in the electron transport pathway between the photosystems.

9689 (DOE/ER/03231—5) Effects of light on respiration and development of photosynthetic cells. Renewal application and progress report, March 1-November 1, 1980. Gibbs, M. (Brandeis Univ., Waltham, MA (USA)). 20 Nov 1980. Contract AS02-76ER03231. 13p. NTIS, PC A02/MF A01.

The oxyhydrogen reaction in the presence and absence of CO_2 was studied in H_2- adapted Scenedesmus obliquus by monitoring the initial rates of H_2, O_2, and $^{14}CO_2$ uptake and the effect of inhibitors on these rates. Glucose and acetate respiration was competitive with H_2 uptake. KCN inhibited equally respiration and the oxyhydrogen reaction in the presence and absence of CO_2. It was concluded that the oxyhydrogen reaction both in the absence and presence of CO_2 has properties in common with components of respiration and photosynthesis. Participation of these two processes in the oxyhydrogen reaction would require a closely linked shuttle between mitochondrion and chloroplast. Protoplasts and chloroplasts will be isolated from a H_2-adapted alga in order to elucidate the cooperation between the two organelles. Acetate was shown to stimulate H_2 photoproduction in H_2-adapted algae even more so than an uncoupler of electron transport. The role of these compounds will be evaluated either in terms of the glyoxylate cycle or electron acceptors resulting in formation of alcohols. The term chloroplast respiration was proposed to account for the breakdown of polyglucan within the chloroplast. A means of reoxidizing reduced pyridine nucleotide was required to complete the cycle. A new enzyme ascorbic acid reduced pyridine nucleotide peroxidase was isolated from the chloroplast. The characterization of this enzyme will continue.

9690 (DOE/ER/03326—T2) Mass spectrometric studies of hydrazine photooxidation by illuminated chloroplasts. Radmer, R.; Ollinger, O. (Martin Marietta Labs., Baltimore, MD (USA)). 1980. Contract AC02-76ER03326. 27p. NTIS, PC A03/MF A01.

Mass spectrometric techniques were used to directly monitor the products evolved during the course of hydrazine (NH_2NH_2) photooxidation by chloroplasts exposed to short saturating flashes or continuous high light. Our results indicate that hydrazine can be used as a reliable probe of Photosystem II provided that (a) N_2 evolution (rather than O_2 uptake) is monitored, and (b) precautions are taken to minimize spurious side reactions. Under conditions in which the participation of superoxide is minimized, N_2 evolution accurately reflects the photooxidation of hydrazine by Photosystem II.

9691 (LBL—11925) I. A comparative study of ribo-, deoxyribo-, and hybrid oligonucleotide helices by nuclear magnetic resonance. II. Optical studies of ethidium binding to oligonucleotides. Pardi, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1980. Contract W-7405-ENG-48. 222p. NTIS, PC A10/MF A01.

Thesis.

The conformations and the helix-to-coil transitions in the following oligonucleotides: (I) a DNA duplex $dCT_5G + dCA_5G$; (II) an RNA duplex $rCU_5G + rCA_5G$; (III) a DNA-RNA hybrid duplex $dCT_5G + rCA_5G$; and (IV) a DNA-RNA hybrid triplex $rCU_5G + dCA_5G$ were studied. The first three mixtures all form stable double helical structures at 5°C, whereas IV forms a triple strand with a ratio of 2:1 rCU_5G:dCA_5G. The chemical shifts of the imino protons in the double strands indicate that I, II, and III have different conformations in solution. This implies a significant change in helical parameters. The chemical shift and sugar pucker data are consistent with helix I having B form geometry, whereas II and III have A (or A') geometry. The chemical shifts of the base protons in system I had transition midpoints of 28 to 30°C indicating an all-or-none transition. The exchange lifetimes of the imino protons on helix I were a factor of two longer, for the interior A.T base pairs, than those on helix III. This reflects the greater stability of the DNA helix compared to the hybrid helix. The two terminal C.G base pairs in helix I were also found to have much different exchange rates, indicative of a sequence dependence for these exchange rates. The thermodynamic properties of ethidium binding to several oligonucleotides were investigated. The order of the stability for the 2:1 oligonucleotide:ethidium complexes was found to be rCpG > dCpG > rCpUpG ≃ rUpA > rGpUpG + rCpC. These complexes present models for a possible mechanism for frameshift mutagenesis by ethidium. A large positive induced circular dichroism (CD) has been observed for ethidium upon intercalation into nucleic acids. (ERB)

9692 Pyrimidine nucleotide pool changes during the cell cycle and quiescence. Pyrimidine excretion and metabolic isolation of the pyrimidine mononucleoside polyphosphate pool. Uziel, M.; Selkirk, J.K. (Oak Ridge National Lab., TN). *Journal of Biological Chemistry, The (U.S.);* **255**: No. 23, 11227-11232(10 Dec 1980).

We have measured the pyrimidine nucleotide contents of the culture fluid, acid-soluble fraction, and acid-insoluble fraction of cultures of hamster embryo fibroblasts (third subculture) through the final two divisions of growth in culture. The cells show a growth delay between the penultimate and ultimate division periods and a concomitant biochemical synchrony of pyrimidine metabolism. The cells exhibit normal excretion of pyrimidine nucleosides beginning with the ultimate division cycle. This excretion results from the net breakdown of ribonucleic acid and a cell-regulated maximum for pyrimidine mononucleoside polyphosphate content.

This upper limit for the pyrimidine nucleoside polyphosphate content is not a steady state phenomenon but rather an absence of both synthesis and utilization. The hamster embryo fibroblast exhibits a directed flow of salvage uridine for ribonucleic acid synthesis. We show that de novo synthetic uridine 5'-monophosphate also can be used for ribonucleic acid synthesis without prior entry into the cytoplasmic uridine nucleoside polyphosphate pool. During attachment and first division salvage uridine does enter the cytoplasmic nucleotide pool. The properties of the cytidine pools differ from the uridine pools in specific activity and levels of cytidine, due to turnover of the terminal C-C-A of cytoplasmic transfer ribonucleic acid and the delay in conversion of nonradioactive de novo synthetic uridine 5'-monophosphate to cytidine 5'-triphosphate. The partial synchrony in these cultures has been used as a temporal marker of the observed events.

9693 **Effect of photoperiod on the levels of endogenous gibberellins in spinach as measured by combined gas chromatography-selected ion current monitoring.** Metzger, J.D.; Zeevaart, J.A.D. (Michigan State Univ., East Lansing). Contract EY-76-C-02-1338. *Plant Physiology (U.S.);* **66**: No. 5, 844-846(Nov 1980).

The changes in the levels of five endogenous gibberellins (GAs) in spinach in relation to photoperiodic treatment have been examined by combined gas chromatography-selected ion current monitoring. Long-day treatment caused a 5-fold decline in the level of GA_{19} while the levels of GA_{20} and GA_{29} increased dramatically during the same period. In absolute terms, the level of GA_{20} increased from 0.8 microgram per 100 grams dry weight in short days to 5.5 micrograms per 100 grams dry weight after 14 long days. The levels of GA_{17} and GA_{44} did not change significantly with long-day treatment. These results are consistent with the hypothesis that GA_{19} is converted to GA_{20} and that this conversion is under photoperiodic control. Since stem growth in spinach is correlated with an increase in the level of GA_{20}, one major aspect of photoperiodic control of stem growth might be the availability of GA_{20} through regulation of the conversion of GA_{19} to GA_{20}.

9694 **Orientation of membrane bound radicals. An EPR investigation of magnetically ordered spinach chloroplasts.** Dismukes, G.C.; Sauer, K. (Univ. of California, Berkeley). *Biochimica et Biophysica Acta (Netherlands);* **504**: 431-445(1978).

The orientation of membrane-bound radicals in spinach chloroplasts is examined by electron paramagnetic resonance (EPR) spectroscopy of chloroplasts oriented by magnetic fields. Several of the membrane-bound radicals which possess g-tensor anisotropy display EPR signals with a marked dependence on the orientation of the membranes relative to the applied EPR field. The fraction of oxidized and reduced plastocyanin, P-700, iron-sulfur proteins A and B, and the X center, an early acceptor of Photosystem I, can be controlled by the light intensity during steady-state illumination and can be trapped by cooling. The X center can be photoreduced and trapped in the absence of strong reductants and high pH, conditions previously found necessary for its detection. These results confirm its role as an early electron acceptor in P-700 photo-oxidation. X is oriented with its smallest principal g-tensor axis (g/sub x/) predominantly parallel to the normal to the thylakoid membrane, the same orientation as was found for an early electron acceptor based on time-resolved electron spin polarization studies.

5503 Cytology

REFER ALSO TO CITATION(S) 9692

9695 **(COO—3162-52) Orientation of the hemes of high potential cytochromes relative to photosynthetic membranes, as shown by the linear dichroism of oriented preparations.** Vermeglio, A.; Breton, J.; Barouch, Y.; Clayton, R.K. (Cornell Univ., Ithaca, NY (USA)). 1979. Contract AS02-76ER03162. 28p. NTIS, PC A03/MF A01.

The orientations of high potential cytochromes with respect to photosynthetic membranes was investigated in spinach chloroplasts and in Rhodopseudomonas viridis. The general approach consists of detection with polarized light of photoinduced absorbance changes related to the oxidation of the cytochromes. The orientation of cytochrome c_{558} was measured at room temperature in chromatophores and whole cells of Rp. viridis, oriented on glass slides and in a magnetic field respectively. The orientation of cytochrome b_{559} of green plants was detected at 77K in magnetically oriented chloroplasts. In both cases the dichroic ratio for the α band shows that the heme plane makes an angle greater than 35° with the membrane plane. Moreover, the dichroic ratio is not constant throughout the α and β bands, for both cytochrome c_{558} and b_{559}. Linear dichroism spectra of oriented pure horse heart cytochrome c and cytochrome c_2 of Rhodopseudomonas sphaeroides in stretched polyvinyl alcohol films show that the variations of the dichroic ratio in the α and β bands can be explained by the occurrence of x and y polarized transitions absorbing at slightly different wavelengths.

9696 **(COO—3162-53) Annual progress report, December 1, 1979-November 30, 1980.** Clayton, R.K. (Cornell Univ., Ithaca, NY (USA)). 1980. Contract AS02-76ER03162. 8p. (COO—3162-54(App.B)). NTIS, PC A02/MF A01.

Structure and function in photosynthetic membranes and their components continue to be studied, principally with Rhodopseudomonas sphaeroides. We have discovered how to remove bacteriochlorophyll (bchl) from a specific binding site in the antenna pigment-protein complex B850, and to replace the bchl without denaturing the complex. This has never before been achieved for any photosynthetic chlorophyllprotein complex. It opens a substantial vista of experiments designed to elucidate the nature of the binding site. Our analyses of the B850 and B875 complexes cast doubt on the accepted ratios of bchl components, carotenoids and protein and hence on models based on these ratios. We have shown that Rp. sphaeroides contains a specific second quinone (Q/sub b/) in contact with the primary photochemical electron acceptor (Q/sub a/) and distinct from the molecules of a larger pool of quinone. We have resolved conflicting reports about the polypeptide composition of reaction centers from Rhodopseudomonas viridis. We have new data on the orientation, relative to the photosynthetic membrane, of cytochrome 552 in Rp. viridis and of the shifting component of carotenoid in Rp. sphaeroides. We have constructed and are using a new circular dichroism spectrometer.

9697 **Role of G_0-G_1 arrest in the inhibition of tumor cell growth by interferon.** Creasey, A.A. (Stanford Univ., CA); Bartholomew, J.C.; Merigan, T.C. Contract W-7405-ENG-48. *Proceedings of the National Academy of Sciences of the United States of America (U.S.);* 77: No. 3, 1471-1475(Mar 1980).

We report here the human leukocyte interferon preparations are capable of influencing the transition of human melanoma cells from the A state to the B phase. Human melanoma cells that enter a quiescent stage at high cell density are more sensitive to the cytostatic action of interferon than those that continue to proliferate under similar conditions. Cell cycle perturbations caused by interferon in these cells include a decreased transition rate out of G_0-G_1 (A state) into S (B phase) and a prolongation of S. These findings support the idea that some metabolic event is required for progress through the G_0-G_1 phase of the cell cycle and is susceptible to interferon action.

9698 **Classification of cultured mammalian cells by shape analysis and pattern recognition.** Olson, A.C.; Larson, N.M.; Heckman, C.A. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Proceedings of the National Academy of Sciences of the United States of America (U.S.);* 77: No. 3, 1516-1520(Mar 1980).

We have developed a method for classifying cultured cells on the basis of shape characteristics. High-resolution optical information on three-dimensional shape was obtained by anodic oxide interferometry. Each interference order formed in a cell was considered as a closed figure; measurement of 37 mathematical descriptors was carried out for each figure. The individual cells were classified according to the values of their descriptors. We used standard principles of pattern recognition, such as hierarchical cluster analysis and nearest neighbor analysis, as a basis for ordering the cells into groups. Alternatively, linear discriminant functions could be

used, but they provided only a slight improvement in correct classification of the cells. We anticipate that the method will be appropriate for classification of cultured cell lines and for determination of the magnitude and direction of cell shape changes implicated in various biological processes.

5504 Genetics

9699 (DOE/EV/72002—49) Ontogeny of the barley plant as related to mutation expression and detection of pollen mutations. Hodgdon, A.L.; Marcus, A.H.; Arenaz, P.; Rosichan, J.L.; Bogyo, T.P.; Nilan, R.A. (Washington State Univ., Pullman (USA). Dept. of Agronomy and Soils). 29 May 1980. Contract AT06-76EV72002. 12p. (CONF-8005134—2). NTIS, PC A02/MF A01.

From Conference on pollen systems to detect biological activity of environmental pollutants; Knoxville, TN, USA (6 May 1980).

Clustering of mutant pollen grains in a population of normal pollen due to premeiotic mutational events complicates translating mutation frequencies into rates. Embryo ontogeny in barley will be described and used to illustrate the formation of such mutant clusters. The nature of the statistics for mutation frequency will be described from a study of the reversion frequencies of various waxy mutants in barley. Computer analysis by a jackknife method of the reversion frequencies of a waxy mutant treated with the mutagen sodium azide showed a significantly higher reversion frequency than untreated material. Problems of the computer analysis suggest a better experimental design for pollen mutation experiments. Preliminary work on computer modeling for pollen development and mutation will be described.

5505 Metabolism

9700 Protection of cellulose synthesis in detached cotton fibers by polyethylene glycol. Carpita, N.C.; Delmer, D.P. (Michigan State Univ., East Lansing). *Plant Physiology (U.S.);* **66**: No. 5, 911-916(Nov 1980).

Detachment of the cotton fiber cell from the ovule results in loss of over 90% of the in vivo capacity for synthesis of [^{14}C]cellulose from [^{14}C]glucose. However, over 50% of the capacity for cellulose synthesis in the detached fiber population is protected when polyethylene glycol 4000 is present during detachment and incubation. Radioautography shows that approximately full capacity is restored in about half the fibers, whereas the other half of the population are incapable of cellulose synthesis from supplied glucose. The rate of cellulose synthesis in such fibers has a pH optimum of 6 and the optimum polyethylene glycol 4000 concentration is 0.06 molal (-9 bars). Cellulose synthesis in such detached fibers is synergistically stimulated by Ca^{2+} and Mg^{2+} and inhibited by K^{+}. Evidence is presented which indicates that the protection by polyethylene glycol 4000 is due to its ability to promote membrane resealing, which seems to be required for protecting cellulose synthesis in the detached fiber; however, the requirement for membrane integrity is not exclusively involved in the maintenance of an energy generating system for the synthesis. The possibility that a membrane potential may be required for maintaining an active cellulose synthesizing system is discussed.

5506 Medicine

REFER ALSO TO CITATION(S) 9493, 9697, 9724

9701 (AD-A—084745) Radiolabeled microsphere technique in conscious subjects during acceleration exposures on the USAFAM centrifuge. Final report, August 1977-November 1978. Laughlin, M.H.; Jaggars, J.L. (School of Aerospace Medicine, Brooks AFB, TX (USA)). Mar 1980. 17p. NTIS, PC A02/MF A01.

The methods used to apply the radiolabeled microsphere technique for the study of the effects of +Gz acceleration on regional blood flows are presented. A remote-control system designed to infuse suspensions of microspheres into the left atrium on conscious animals is outlined as is a device which allows the remote, sequential withdrawal of six blood samples. Results are presented which demonstrate that the cautious application of the radiolabeled microsphere technique using the outlined systems can produce good information about the effects of +Gz acceleration on regional blood flows.

9702 Therapeutic synergism of hyperthermia-cis-platinum in a mouse tumor model. Alberts, D.S. (Univ. of Arizona, Tucson); Peng, Y.M.; Chen, H.S.G.; Moon, T.E.; Cetas, T.C.; Hoeschele, J.D. *Journal of the National Cancer Institute (U.S.);* **65**: No. 2, 455-461(Aug 1980).

A small-animal model was developed as a guide to whole-body hyperthermia in cancer patients. Anesthetized DBA/2 mice were secured to a platform, and their hindlimbs were immersed in a 42.3°C water bath for 30 to 60 minutes. Hindlimb hyperthermia resulted in steady-state rectal and femoral bone marrow and muscle temperatures of 42°C and upper extremity muscle and esophagus temperatures of 41°C. With this hyperthermia technique, the mouse spleen colony assay could be used to quantitate the lethality of hyperthermia and/or cis-dichloro-diammineplatinum(II) (cis-platinum) on clonogenic bone marrow and leukemia cells. Hyperthermia prior to cis-platinum administration increased cis-platinum inhibition of leukemia colony formation as much as 2 logs; however, antileukemia synergism was greatest when cis-platinum administration immediately preceded hyperthermia and no evidence existed of synergism against normal bone marrow colonies. Correlative in vivo drug uptake studies showed a marked increase in leukemia cell uptake of /sup 195m/Pt-cis-platinum at elevated temperatures, which suggested a potential mechanism for the apparent antileukemia synergism of cis-platinum and heat.

9703 (LA—8639-PR) Serologic test systems development. Progress report, October 1, 1978-September 30, 1979. Seawright, G.L.; Sanders, W.M.; Hollstein, U.; Butler, J.E.; Mills, K.W.; Despommier, D.D.; Zimmerman, W.J.; Martinez, E.; Hindman, K.R.; Payne, R.J. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 46p. NTIS, PC A03/MF A01.

Work has continued on the development and automation of enzyme immunoassays (EIA) for detecting diseases and toxic agents in food animals. Further evaluations were made of the Technicon Autoanalyzer II(AAII) for conducting totally automated EIAs. The problems investigated were machine carryover and assay variation. Modifications greatly reduced or eliminated carryover and produced acceptable levels of test variation. The EIA for swine trichinosis was significantly improved by the use of a new, partially purified antigen preparation. The result was improved detection of early seroconversions and reduced probability for false negatives and false positives. The amplified EIA was adapted as a diagnostic test for bovine brucellosis and studies were initiated for differentiating vaccinated and infected animals. Preliminary data indicate that the IgG_1 response may be diagnostic but further studies are necessary. Development of the EIA for detecting low molecular weight contaminants and residues in food products was also initiated. Compounds studied were the antibiotics chloramphenicol, tetracycline, and gentamicin; the mycotoxin, aflatoxin, and the shale oil toxin, 2-aminofluorene. Results indicate that chloramphenicol nonspecifically binds to antibody and interferes with antibody activity. Thus, the test is not yet satisfactory. Initial attempts to automate the gentamicin test were unsuccessful because of machine carryover but modifications of the AAII have produced encouraging preliminary data. Work is continuing on the development of EIAs for all of the compounds mentioned above. (ERB)

9704 (LA-UR—80-3699) Heavy particle radiotherapy: prospects and pitfalls. Faju, M.R. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 29p. (CONF-8010153—1). NTIS, PC A03/MF A01.

From LST Arab conference on medical physics; Beirut, Lebanon (30 Oct 1980).

The use of heavy particles in radiotherapy of tumor volumes is examined. Particles considered are protons, helium ions, heavy ions, negative pions, and fast neutrons. Advantages and disadvantages are discussed. (ACR)

9705 (LBL—11037) Semiconductor detectors for medical tomography with high-energy heavy ions. Llacer, J.; Haller, E.E.; Hansen, W.L.; Walton, J.T.; Batho, E.K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1980. Contract W-7405-ENG-48. 7p. (CONF-801103—45). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

High-energy heavy ion beams are in use at the Lawrence Berkeley Laboratory for cancer therapy. In order to take full advantage of the very favorable depth-dose characteristics of those beams, it is necessary to determine the stopping characteristics of the ions in the complex media of a human with greater accuracy than obtainable with x-ray CAT scanning. Initial measurements with an array of Si dE/dx position sensitive detectors and a windowless thin planar Ge detector used in a side entry mode show the potential for fabricating an instrument for high accuracy on-line CAT scanning using the same ions to be used for therapy. It is estimated that one tomography can be obtained with a dose of 0.72 Rad-gm.

9706 Dexamethasone-suppression adrenal scintigraphy in hyperandrogenism: concise communication. Gross, M.D.; Freitas, J.E.; Swanson, D.P.; Woodbury, M.C.; Schteingart, D.E.; Beierwaltes, W.H. (Univ. of Michigan Medical Center, Ann Arbor). Contract EY-76-S-02-2031. *Journal of Nuclear Medicine (U.S.);* **22**: No. 1, 12-17(Jan 1981).

From 28. annual meeting of Society of Nuclear Medicine; Las Vegas, NV, USA (16 Jun 1981).

To assess the contribution of adrenal-derived androgens in women with hirsutism, adrenal scintigrams under dexamethasone suppression (DS) were performed on 35 women with increasing facial or body hair and irregular or absent menses. Based upon the DS regimen chosen (8 mg/d for 2 days or 4 md/d for 7 days before the injection of 6β-[^{131}I]iodomethylnorcholesterol), three imaging patterns were identified. The first was the absence of uptake before 3 days (8-mg DS) or before 5 days (4-mg DS) after injection. This imaging pattern was seen in 17 of the 35 patients studied and was considered normal. The second pattern was bilateral uptake earlier than 3 days (8-mg DS regimen) or 5 days (4-mg DS) after injection. This was seen in 13 of the 35 patients and was interpreted as bilateral early visualization. Adrenal-vein catheterization performed on six patients with this pattern showed increased adrenal-vein testosterone. The third pattern, observed in five patients, was unilateral early visualization, which in four cases investigated to date was the result of an adrenocortical adenoma. This study confirms the adrenal cortex as a source of androgens in women with hirsutism and hyperandrogenism and demonstrates that DS adrenal scintigraphy can be utilized to identify those women in whom adrenal-derived androgens contribute to their hyperandrogenism.

9707 Myocardial imaging with a radioiodinated norepinephrine storage analog. Wieland, D.M.; Brown, L.E.; Rogers, W.L.; Worthington, K.C.; Wu, J.L.; Clinthorne, N.H.; Otto, C.A.; Swanson, D.P.; Beierwaltes, W.H. (Univ. of Michigan Medical Center, Ann Arbor). Contract EY-76-S-02-2031. *Journal of Nuclear Medicine (U.S.);* **22**: No. 1, 22-31(Jan 1981).

From 28. annual meeting of Society of Nuclear Medicine; Las Vegas, NV, USA (16 Jun 1981).

Meta-iodobenzylguanidine (M-IBG), an iodinated aromatic analog of the hypotensive drug guanethidine, localizes in the heart of the rat, dog, and rhesus monkey. A comparative study of tissue distribution in the dog has been performed with five myocardiophilic agents: thallium-201, I-125 16-iodohexadecanoic acid, H-3 norepinephrine, C-14 guanethidine and I-125 M-IBG. The last two compounds give heart concentrations and heart-to-blood concentration ratios similar to those of thallium-201. Planar and tomographic images of the hearts of the dog and rhesus monkey were obtained using I-131 or I-123 labeled M-IBG. Blocking studies with reserpine suggest that a major component of myocardial retention of M-IBG is sequestration within the norepinephrine storage vesicles of the adrenergic nerves. The localization of M-IBG in other organs with rich sympathetic innervation and the relative insensitivity of myocardial uptake to a wide range of loading doses lend additional support for a neuronal mode of retention.

9708 16α-[^{77}Br]bromoestradiol-17β: a high specific-activity, gamma-emitting tracer with uptake in rat uterus and induced mammary tumors. Katzenellenbogen, J.A. (Univ. of Illinois, Urbana); Senderoff, S.G.; McElvany, K.D.; O'Brien, H.A. Jr.; Welch, M.J. *Journal of Nuclear Medicine (U.S.);* **22**: No. 1, 42-47(Jan 1981).

From 28. annual meeting of Society of Nuclear Medicine; Las Vegas, NV, USA (16 Jun 1981).

16α-[^{77}Br]bromoestradiol-17β (compound 1) has been synthesized by radiobromination of estrone enoldiacetate. Tissue uptake studies performed 1 hr after administration of compound 1 to immature or mature female rats showed uterus-to-blood ratios of 13, with nontarget tissue-to-blood ratios ranging from 0.6 to 2. Coadministration of unlabeled estradiol caused a selective depression in the uterine uptake with no effect on nontarget tissue uptake. In adult animals bearing adenocarcinomas induced by DMBA (7,12-dimethylbenz(a)anthracene), tumor-to-blood ratios of 6.3 were obtained, this uptake also being depressed in animals treated with unlabeled estradiol. The studies demonstrate that compound 1 has suitable binding properties and sufficiently high specific activity so that its uptake in estrogen target tissues in vivo is mediated primarily by the estrogen receptor. Furthermore, they suggest that this compound may be suitable for imaging human breast tumors that contain estrogen receptors.

9709 Iridium-191 angiocardiography for the detection and quantitation of left-to-right shunting. Treves, S.; Cheng, C.; Samuel, A.; Lambrecht, R.; Babchyck, B.; Zimmerman, R.; Norwood, W. (Harvard Medical School, Boston, MA). Contract EY-76-S-4115. *Journal of Nuclear Medicine (U.S.);* **21**: No. 12, 1151-1157(Dec 1980).

An osmium-191 → iridium-191 generator that can deliver multiple doses of Ir-191m for first-pass radionuclide angiography has been developed. Iridium-191m has a physical half-life of 4.96 sec and decays with emission of 65-keV and 129-keV photons in 58 and 30% abundance, respectively. Using a gamma camera, Ir-191m radionuclide angiography was carried out, in dogs and ten patients, for the detection and quantitation of left-to-right shunting. In a one-year-old patient, 25 mCi of Ir-191m results in a whole-body radiation absorbed dose of 35 mrad. Multiple Ir-191m angiograms can be performed, seconds to minutes apart, without interference from background. The 15.4-day half-life of Os-191 permits transportation of the generator to centers far from the production facility. With the low radiation dose, high information density, and the ability to repeat studies with Ir-191m, clinical use of radionuclide angiography should be expanded.

9710 New osmium-191 → iridium-191m generator. Cheng, C.; Treves, S.; Samuel, A.; Davis, M.A. (Harvard Medical School, Boston, MA). Contract EY-76-S-4155. *Journal of Nuclear Medicine (U.S.);* **21**: No. 12, 1169-1176(Dec 1980).

A new osmium-191→iridium-191m generator suitable for first-pass radionuclide angiocardiography has been developed. This generator system allows repeated elutions of 4.96-sec iridium-191m from its 15.4-day Os-191 parent. The Os-191 is loaded on an anion-exchange column (AGMP-1) and Ir-191m eluted with 0.9% NaCl at pH 1. Each elution (0.6 to 1 ml) of the generator yields about 7 to 10% Ir-191m and gives 0.003 to 0.008% of Os-191 breakthrough. Toxicity studies of the generator eluate carried out in animals support the safety of using iridium-191m in humans. The long shelf-life of the generator ($\simeq$ 2 wk) will allow medical centers to use Ir-191m for routine clinical diagnosis. Iridium-191m obtained by this method should find additional useful applications in nuclear medicine.

9711 Scheduling of hypoxic-tumor therapy using neutron brachytherapy. Maruyama, Y.; Beach, J.L.; Feola, J. (Univ. of Kentucky, Lexington). *Radiology (U.S.);* **137**: No. 3, 775-781(Dec 1980).

From 65. scientific assembly and annual meeting of the Radiological Society of North America; Atlanta, GA, USA (25 Nov 1979).

Fast-neutron-beam therapy and low-dose-rate fast-neutron intracavitary therapy of cervical carcinoma are effective in producing regression of advanced tumors. However, effectiveness is critically dependent on the schedule by which they are used in combination

with fractionated external low-linear-energy-transfer (LET) therpy. Neutron-beam therapy is now alternated frequently with fractionated external radiotherapy (mixed beam). Intracavitary neutron therapy, scheduled before fractionated external-beam photon therapy, was maximally effective. These findings indicate that traditional concepts developed for the use of conventional low-LET therapy may need to be altered to use neutrons for therapy and to achieve improved local control of advanced cancers.

9712 **Californium-252 dosimetry in phantoms of various dimensions.** Sabau, M.N.; Lanzi, L.H.; Rozenfeld, M. (Univ. of Chicago, IL). Contract EY-76-C-02-0069; EY-76-C-09-0743-M006. *Radiology (U.S.);* **137**: No. 3, 789-793(Dec 1980).

From 65. scientific assembly and annual meeting of the Radiological Society of North America; Atlanta, GA, USA (25 Nov 1979).

By using a tissue-equivalent (TE) ionization chamber filled with TE gas and a magnesium ionization chamber filled with argon gas as the dosimeter pair for the twin-chamber method, the authors obtained the neutron and gamma-ray components of the radiation dose from californium 252 (^{252}Cf). The distribution of dose components as a function of different phantom dimensions was determined. The effect of neutron absorption and scattering was evaluated, as well as the absorption and production of gamma rays in the phantom. The results can be used for improvement of ^{252}Cf dosimetry when using a body of finite dimensions.

5507 Microbiology

9713 (SAND—80-2744, pp 43-56) **Disease control requirements for various sludge uses.** Tonetti, R. (Environmental Protection Agency, Washington, DC). Dec 1980.

From National symposium on the use of cesium-137 to process sludge for further reduction of pathogens; Denver, CO, USA (3 Sep 1980).

Micropathogens within sewage sludge or sludge products have been shown in many well-documented cases to pose a health hazard to humans. Both direct and indirect routes for transmission of disease-causing organisms from sludge are recognized. Direct routes include direct contact with sludge-applied gardens, playgrounds, and parks, while indirect routes include the ingestion of garden produce, fruits, and vegetables grown in or close to sludge-amended soils. In parasitic infestations, the life cycle of the parasite is a further consideration. Demonstration that the longevity of certain pathogens in sludge-amended soil can be significant has led to the establishment of the disease control criteria of the new regulation 40 CFR Part 257. The new regulation limits human contact with sludge-amended soils and growth of food-chain crops in such soils unless specified sludge treatment methods are practiced which provide for sludge disinfection and disinfestation prior to application to land. The implications of the disease control criteria of the 40 CFR 257 regulation and processes applicable to sludge disinfection are discussed.

9714 **Poliovirus retention in 75-cm soil cores after sewage and rainwater application.** Landry, E.F.; Vaughn, J.M.; Penello, W.F. (Brookhaven National Lab., Upton, NY). *Applied and Environmental Microbiology (U.S.);* **40**: No. 6, 1032-1038(Dec 1980).

The adsorption rate of a guanidine-resistant strain of poliovirus LSc 2ab was measured in Long Island soils with in situ field cores (10.1 by 75 cm). The test virus was chosen because it exhibited soil adsorption and elution characteristics of a number of nonpolioviruses. After the inoculation of cores with seeded sewage effluent at a 1-cm/h infiltration rate, cores were extracted, fractionated, and analyzed for total plaque-forming units per each 5-cm fraction. The results showed that 77% of the viruses were adsorbed in the first 5 cm of soil. An additional 11% were found in the 5- to 10-cm fraction, and a total of 96% of the viruses were adsorbed by 25 cm. The remaining 4% were uniformly distributed over the next 50 cm of soil, with a minimum of 0.23% in each soil section. Few viruses (< 0.22%) were observed in core filtrates. Analysis of the viral distribution pattern in seeded cores, after an application of a single rinse of either sewage effluent or rainwater, indicated that large-scale viral mobilization was absent. However, localized areas of viral movement were noted in both of the rinsed cores, with the rainwater rinsed cores exhibiting more extensive movement. All mobilized viruses were resorbed at lower core depths.

5508 Morphology

REFER ALSO TO CITATION(S) 9687, 9698

9715 **Siphonal eyes of giant clams and their relationship to adjacent zooxanthellae.** Fankboner, P.V. (Simon Fraser Univ., Burnaby, British Columbia). *Veliger, The (U.S.);* **23**: No. 3, 245-249(1 Jan 1981).

Giant clams of the genus Tridacna possess up to several thousand eyes upon the surface of their exposed hypertrophied siphons; this extraordinary number of eyes is unique in the animal kingdom. The siphonal eyes of Tridacna are simple photoreceptors that lack a lens, but possess a pigment cup made of several to many layers of olive-green zooxanthellae. Each eye contains 280 to 350 polygonal retinal cells (15 to 20 μm in diameter) which bear numerous ciliary blebs. Retinal cell blebs posses a ciliary axoneme composed of 9 x 2 + 0 microtubule doublets which splay outwards from the cilium's basal plate. The ciliary blebs give rise to many microvilli that are believed to be the photoreceptive portion of the retinal cell. Whereas tridacnid eyes possess directional sensitivity, because they lack a lens, they are individually incapable of image discrimination. However, both the ability of giant clams to detect nearby movements and the high density of eyes on the siphonal surface indicate that tridacnid eyes may function cooperatively in small numbers much like the elements of a primitive compound eye. Owing to the transparency of the retinal cells and the biconvex shape of the siphonal eye, it is apparent that Yonge's hypothesis that zooxanthellae surrounding the eye's capsule may derive more sunlight than other similar siphonal tissues is reasonable.

5510 Physiological Systems

9716 **(UCRL—52875) Design and fabrication of a portable minicuvette system for measuring leaf photosynthesis and stomatal conductance under controlled conditions.** Bingham, G.E.; Coyne, P.I.; Kennedy, R.B.; Jackson, W.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Aug 1980. Contract W-7405-ENG-48. 66p. NTIS, PC A04/MF A01.

The design specifications and some performance data for a new miniaturized cuvette system suitable for measuring photosynthesis and stomatal conductance in the field are reported. The system operates on 12-V power (dc). An electronic support module is attached by an umbilical cord to a stirred-reaction leaf chamber and a rechargeable battery pack. The chamber is heated or cooled by thermoelectric modules and humidity and CO_2 concentration are kept steady by bleeding in dry air and CO_2-enriched dry air through capillaries. Relative humidity is measured in situ by a fast-response capacitive-type humidity sensor. Carbon dioxide concentration is currently monitored by diverting exhaust gas from the chamber to a conventional infrared gas analyzer. A miniaturized, folded-path infrared gas analyzer is to be incorporated into the system as an in situ CO_2 sensor in a manner analogous to the humidity sensor. True CO_2 can be estimated using $^{14}CO_2$-labeled air. The system features solid-state pressure transducers for monitoring flow rate and digital readout for all parameters. Interfacing for data acquisition and automatic control is provided. Extensive field performance tests have shown that this instrumentation effectively replaces large cuvette systems, while it incorporates many of the desirable features of small, hand-held porometers. (ERB)

9717 **Fat cotent of ectopic marrow implants and cellularity of resulting ossicles.** Maloney, M.A.; Flannery, M.L.; Patt, H.M. (Univ. of California, San Francisco). *Proceedings of the Society for Experimental Biology and Medicine (U.S.);* **165**: No. 2, 309-312(Nov 1980).

The capacity of marrow stroma to transfer a microenvironment conducive to hematopoiesis was studied in rabbits by means of subcutaneous implants of autologous marrow with variable hematopoietic cellularity and fat content as determined by histologic analysis. Cellularity of marrow in ossicles present at the implantation site 3 months later was found to be sigmoidally related to cel-

lularity of the implant. Hypocellular marrow with fat content in excess of 50% was associated with onset of a sharp increase in saturated lipids as revealed by histochemistry. These results, which confirm and extend earlier qualitative observations of a difference in potential of red and yellow marrow upon ectopic implantation, are consistent with the putative regulatory role of stromal elements in hematopoiesis.

5520 Public Health

REFER ALSO TO CITATION(S) 9731

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 8625, 9021, 9022, 9200, 9612, 9613, 9615, 9668, 9669, 9683, 9716

9718 **Climatic variability and agriculture in tropical moist regions.** Fukui, H. (Kyoto Univ., Japan). pp 426-474 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

The discussion in this paper deals with the entire region that is warmer and/or wetter than the temperate and semi-arid regions - not just the equatorial zone. (PSB)

9719 **Climatic variability and agriculture in the semi-arid tropics.** Mattei, F. (National Research Council and Central Office of Agricultural Ecology, Rome, Italy). pp 475-509 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

Differing techniques for land management and cultivation methods are discussed for cold, temperate, and tropical semi-arid regions. (PSB)

9720 **Year-round studies on natural cooling and heating of greenhouses in Northern India.** Mannan, K.D.; Cheema, L.S. (Punjab Agricultural Univ., Ludhiana, India). pp 1699-1703 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The design features and the techniques followed to keep the greenhouses cool in summer are described. The geometry and orientation of the greenhouses have been found to be significant in this respect. Experimental studies have been made on two small greenhouses each of the size 6.75 m x 2.45 m and a height of 2.45 m constructed at Ludhiana, India, latitude 31° north. The greenhouses are oriented in the east-west direction. The effect of blocking sun rays entering from the east and west walls before noon and after noon respectively and the effect of maintaining a thin layer of water at the roof of the greenhouse have been studied with a view to determine the cooling effect. It has been found that a thin layer of water on the roof is very effective in keeping a greenhouse cool in summer by as much as 10 to 12°C during sunshine hours compared with the standard.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

9721 **(COO—4746-3) Ionization in liquids. Progress report, September 1, 1977-April 30, 1981.** Bakale, G. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Radiology). 19 Dec 1980. Contract AS02-78EV04746. 70p. NTIS, PC A04/MF A01.

Portions of document are illegible.

Quasifree electrons simulate the behavior of unsolvated or dry electrons in aqueous media including the special case of biological systems. A model of direct radiosensitization was developed based on dry charge-carriers having an extended lifetime in the sheath of structured water that surrounds polar biomolecules. In this model, the pre-solvation lifetimes of dry electrons increased with an increase in the rotational times of solvent molecules. During the development of this model, an increasing number of radiosensitizers were found to be carcinogenic. Measurement of the k/sub e/'s of known carcinogens and noncarcinogens revealed that carcinogens attached quasifree electrons at diffusion-controlled rates, whereas the k/sub e/'s of noncarcinogens were significantly less. To explore the k/sub e/-carcinogenicity correlation further, a study of quasifree electron attachment to the water pools of reversed micelles was conducted. The degree of structuredness of the water pools which determines the k/sub e/ of the reversed micellar systems was also controlled. Another approach to controlling the microenvironment of quasifree electrons in biological systems was done in studies of radiation-induced damage to DNA in concentrated DNA solutions. The high concentration of DNA introduces more structure into the solutions than that occurring in typical in vitro experiments. The structural enhancement by DNA extends the lifetime of unsolvated charge-carriers. The DNA-damaging effects of radiolyticaly produced charge-carriers were also determined in studies of synergistic mutagenesis in bacteria simultaneously exposed to ionizing radiation and electrophilic chemical carcinogens. The attachment-detachment equilibrium of nicotine in hexane solutions was also studied. Both the kinetics and the thermodynamics of electron reactions were studied. (ERB)

9722 **(COO—4964-2) Inducible error-prone repair in B. subtilis. Progress report, September 1, 1979-February 28, 1981.** Yasbin, R.E. (Pennsylvania State Univ., University Park (USA)). Oct 1980. Contract AS02-78EV04964. 58p. NTIS, PC A04/MF A01.

The mechanism of activation and the mode of action of the SOS system in Bacillus subtilis are being investigated. Interesting aspects of the SOS system in B. subtilis include: (1) the differences between the SOS functions in this bacterium and in the enteric bacteria; (2) the spontaneous activation of SOS functions in competent cells; and (3) the difficulty in establishing the presence of error-prone repair in this bacterium. In order to characterize the SOS system of B. subtilis, attempts will be made to: (1) isolate bacteria mutated in genes controlling various repair functions; (2) investigate inducible repair; (3) determine the role of endogenous prophages in DNA repair phenomena; and (4) utilize competent B. subtilis as a tester system for the detection of potential carcinogens. Data obtained during the past 18 months demonstrate: (1) the ability of the B. subtilis Comptest to detect potential environmental carcinogens; (2) the importance of DNA polymerase III in W-reactivation in B. subtilis; and (3) the control the bacteriophage SPβ has over the inducible DNA modification system in B. subtilis. Furthermore, the data also suggests the lack of error-prone repair in B. subtilis, and the differences which exist between the Bacilli and the enteric bacteria with regards to SOS phenomena. In order to further characterize inducible repair functions in B. subtilis, results will also be presented on attempts to mobilize error-prone repair systems of other bacterial species.

9723 **(LA-UR—80-3669) Cancer risks after radiation exposures.** Voelz, G.L. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 18p. (CONF-8009126—1). NTIS, PC A02/MF A01.

From Conference on the relation of environmental pollution to the cancer problem; Lakewood, CO, USA (Sep 1980).

A general overview of the effects of ionizing radiation on cancer induction is presented. The relationship between the degree of risk and absorbed dose is examined. Mortality from radiation-induced cancer in the US is estimated and percentages attributable to various sources are given. (ACR)

9724 **(ORNL/TM—7482) Nuclear medicine technology progress report for quarter ending June 30, 1980.** Knapp, F.F. Jr. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 23p. NTIS, PC A02/MF A01.

Results of experiments demonstrated that the alkyl portion of 9-telluraheptadecanoic acid [9-THDA] is retained in the myocardial tissue of rats to the same extent as radioactivity from

123m/Te-9-THDA. Tissue distribution experiments in rats one hr after injection of 10-[^{14}C]-9-telluraheptadecanoic acid were compared with the results of a parallel study using /sup 123m/Te-9-THDA. The results indicate that the alkyl region of 9-THDA is retained in the myocardium and that labeling of this portion of the 9-THDA molecule with radiohalogens such as ^{123}I may be an attractive approach for evaluation of myocardial function. Results of preliminary studies for the development of radiolabeled barbiturates as a new class of agents for the measurement of regional blood perfusion in the brain are also described. Several new barbiturates substituted at the C-5 position were prepared and characterized. These compounds will be labeled with /sup 117m/Sn, ^{75}Se, and /sup 123m/Te and brain uptake studies performed in rats. Studies of arsenic trioxide (As_2O_3) toxicity for human cells in the diffusion chamber assay system have continued. Studies employing $^{74}As_2O_3$ have demonstrated that uptake of radioactivity from test substances administered to rats can be detected in cells taken from the intraperitoneally-implanted diffusion chambers. Preliminary synthetic studies of gold-based antirheumatoid complexes are also reported. Several ^{11}C-labeled amino acids have been prepared for clinical testing. Platinum-195m-labeled-cis-dichlorodiammine-platinum(II) was supplied to collaborators for further testing and ^{75}Se- and /sup 123m/Te-labeled long-chain fatty acids were supplied to several medical investigators for the evaluation of myocardial function in experimental animals. (ERB)

9725 **(ORO—3728-13) Mutagenic effect of radionuclides incorporated into DNA of Drosophila melanogaster. Progress report, 1978-1979.** Lee, W.R. (Louisiana State Univ., Baton Rouge (USA). Dept. of Zoology and Physiology). 1979. Contract AS05-76EV03728. 15p. NTIS, PC A02/MF A01.

Current progress in studies on the mutagenic effect of ^{3}H incorporated into the DNA of Drosophila melanogaster is reported. It was shown that selected ^{3}H precursors incorporated into DNA are metabolized. The forms (metabolites) of tritium found in the DNA molecules and the mutation frequencies resulting therefrom were identified. An alcohol dehydrogenase system was developed for recovering mutations that is capable of distinguishing between base changes and chain breakage events that may lead to the formation of deletions. (ERB)

9726 **(PNL-SA—8091) Comparison of rats and dogs exposed to $^{239}PuO_2$.** Mahaffey, J.A.; Sanders, C.L.; Park, J.F.; Dagle, G.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract AC06-76RL01830. 11p. (CONF-791077—6). NTIS, PC A02/MF A01.

From Workshop on measurement and interpretation of actinide accumulation by man; Snowbird, UT, USA (14 Oct 1979).

Rats and dogs inhaled aerosols of $^{239}PuO_2$ at comparable ages relative to their lifespan. Both received a single exposure. The estimated lung doses at death in dogs were between 1100 and 11,000 rad. From two inhalation experiments, rats receiving doses in this range were chosen from the high-level exposed animals for comparison. Based on this data base, several comparisons were investigated. Metabolism of the material was compared for all animals and for animals which developed lung tumors. The differences in histopathology and tumor incidence in the lung were also reviewed. Although there were several differences between species, there were also many similarities. On-going research in dogs should produce data which will allow clarification of these relationships.

9727 **(SAND—80-2744) Sludge irradiation disinfection for beneficial use.** (Sandia National Labs., Albuquerque, NM (USA)). Dec 1980. Contract AC04-76DP00789. 342p. (CONF-800964—). NTIS, PC A15/MF A01.

From National symposium on the use of cesium-137 to process sludge for further reduction of pathogens; Denver, CO, USA (3 Sep 1980).

Papers given at the symposium are included in this volume. The symposium was organized to facilitate the transfer of information on the use of sludge irradiation as a process to further reduce pathogens. State-of-the-art gamma radiation of dried sewage solids is reviewed. Separate abstracts have been prepared for individual papers for inclusion in the Energy Data Base. (DMC)

9728 (SAND—80-2744, pp 175-192) **Operating experience with gamma ray irradiators.** Fraser, F.M.; Ouwerkerk, T. (CONF-800964). Dec 1980.

In Sludge irradiation disinfection for beneficial use.

The experience of Atomic Energy of Canada, Limited (AECL) with radioisotopes dates back to the mid-1940s when radium was marketed for medical purposes. Cobalt-60 came on the scene in 1949 and within a few years a thriving business in cancer teletherapy machines and research irradiators was developed. AECL's first full-scale cobalt-60 gamma ray sterilizer for medical products was installed in 1964. AECL now has over 50 plants and 30 million curies in service around the world. Sixteen years of design experience in cobalt-60 sources, radiation shielding, safety interlock systems, and source pass mechanisms have made gamma irradiators safe, reliable, and easy to operate. This proven technology is being applied in promising new fields such as sludge treatment and food preservation. Cesium-137 is expected to be extensively utilized as the gamma radiation source for these applications.

9729 **(SAND—80-7133) Uptake and retention of radionuclides by marine organisms: a bibliography prepared for the Seabed Program.** Schultz, V. (comp.). (Washington State Univ., Pullman (USA). Dept. of Zoology). Dec 1980. Contract AC04-76DP00789. 146p. NTIS, PC A07/MF A01.

An extensive bibliography on marine radiation ecology has been prepared. It is organized according to freshwater/saltwater animal and plant classification. (DMC)

9730 **(SAND—80-7143) Effects of low-level radiation on biologic systems: a literature review.** Best, T.L.; Hoditschek, B. (eds.). (Eastern New Mexico Univ., Portales (USA)). Dec 1980. Contract AC04-76DP00789. 246p. NTIS, PC A11/MF A01.

This review presents an organized survey of scientific literature dealing with the biologic effects of low-level radiation. It includes brief discussions of topics of particular interest, a listing of useful review articles, an extensive bibliography, and listings of sources that can be used to update this document in the future. The topics discussed include experimental studies, the linear hypothesis, medical effects, occupational effects, effects of exposure to naturally occurring radiation, consumer products, and laws and regulations.

9731 **Effects of low-level radiation and comparative risk.** Sinclair, W.K. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *Radiology (U.S.);* **138**: No. 1, 1-9(Jan 1981).

From 65. scientific assembly and annual meeting of the Radiological Society of North America; Atlanta, GA, USA (25 Nov 1979).

At low doses of radiation to the whole body, the dose-effect relationship for humans must usually be determined by extrapolation from human data at high doses. Reasons for above-linear, linear, or below-linear extrapolation from high doses to low doses are discussed. The linear extrapolation is most common, and probably leads to conservative estimates of risk. Risks from other carcinogens may be compared directly with radiation risk by using cancer incidence as the end point. However, lifeshortening is a more useful index of comparison in many other circumstances, and can be used to compare the time lost due to radiation-induced cancer with that due to accidental deaths and other lost industrial time. Risks for radiation workers exposed at current average occupational dose levels are shown to be comparable with those from other safe industries. Questions of acceptability and public perception of risk are briefly discussed.

9732 **Nonparametric representation of dose-effect relations.** Kellerer, A.M. (Institut fuer Medizinische Strahlenkunde der Universitaet Wuerzburg, Germany); Chmelevsky, D.; Hall, E.J. Contract EP-78-S-02-4733. *Radiation Research (U.S.);* **84**: No. 2, 173-188(Nov 1980).

A method is described that permits a least-squares fit of survival data without invoking analytical expressions for the survival curve. As a more general constraint, applicable to a broad range of experimental data, convexity (from above) in the semilogarithmic representation is utilized. The application of the method to individual survival curves is illustrated by a numerical example. The actual

purpose of the method is, however, the analysis of sets of survival curves that differ by dose-modifying factors. The need for such joint fits arises, for example, in the biological intercomparison of neutron beams for radiotherapy, or in the determination of the oxygen enhancement ratio. It is exemplified here in the application of the method to a set of repeated survival experiments for hamster cells exposed to X rays. The method provides an estimated theoretical survival curve that is based on the total set of data, and it also yields a set of dose-modifying factors that represent deviations from the ideal curve in the individual experiments.

9733 **Evidence that the oxygen enhancement ratio for pink somatic mutations in Tradescantia stamen hairs may approach unity at very low x-ray doses.** Underbrink, A.G.; Woch, B. (College of Physicians and Surgeons of Columbia Univ., New York, NY). *Radiation Research (U.S.);* **84**: No. 2, 301-306(Nov 1980).

Experimental evidence was found that the oxygen enhancement ratio (OER) for pink somatic mutations in the stamen hairs of Tradescantia clone 02 appears to reach unity at X-ray doses of 2 to 3 rad. There is also a small segment on the dose-response curves from about 3 to 10 rad where the OER appears to be dose-dependent. At higher doses the aerated and hypoxic curves are parallel, and the OER is 3.2 up to doses where the mutation frequency reaches a plateau.

9734 **Effects of inhaled ^{144}Ce on cardiopulmonary function and histopathology of the dog.** Mauderly, J.L.; Muggenburg, B.A.; Hahn, F.F.; Boecker, B.B. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). Contract DE-AC04-76EV01013. *Radiation Research (U.S.);* **84**: No. 2, 307-324(Nov 1980).

Twelve dogs inhaled single doses of relatively insoluble particles containing ^{144}Ce and six dogs inhaled particles containing stable cerium as controls. Pulmonary function, clinical, and radiographic evaluations were performed serially. The dogs developed progressive radiation pneumonitis and pulmonary fibrosis similar to that previously reported for whole-lung irradiation from internal or external sources. Focal histologic changes in bronchioles and alveoli were detected functionally during treadmill and tube-breathing stresses at a time when the dogs' clinical and radiographic appearances were normal. Moderate functional impairment was associated with more severe inflammatory and proliferative changes in airways and alveoli. Severe impairment resulted from progressive fibrosis and scarring. These were several strong correlations between functional indices and histological scores. There was a nonlinear relationship between cumulative radiation dose and effects, and once the functional alterations became clinically evident, the disease progressed with little further increase in dose.

9735 **Distribution and pathological effects of Pu in juvenile beagles.** Bruenger, F.W. (Univ. of Utah, Salt Lake City); Stevens, W.; Stover, B.J.; Taylor, G.N.; Smith, J.M.; Buster, D.S.; Atherton, D.R. Contract EY-76-C-02-0119. *Radiation Research (U.S.);* **84**: No. 2, 325-342(Nov 1980).

Twelve juvenile beagles 90 days old were injected intravenously with 2.8 μCi ^{239}Pu/kg. All attained normal skeletal size and normal weight. However, all died from osteosarcoma with an average survival time of 1306 +- 163 days after injection. At death the liver contained 12.7 +- 2% of the injected ^{239}Pu, and less than 1% was in the total of kidneys, lung, and spleen. In a liver homogenate, free of nuclei and debris, most of the Pu was bound to ferritin in the cytosol or found with microsomes. No overt evidence of radiation-induced liver damage was discernible. At death, the juvenile skeletons contained 56.0 +- 3.1% compared to 44% in beagles injected as young adults. Highly active bone growth and turnover produced a skeletal redistribution pattern of Pu which differed from that observed in young adults. The cumulative average dose to the anatomical skeleton was 2850 +- 443 rad. Seventeen bone tumors were produced, located predominantly in areas with high concentrations of Pu and rapid bone turnover rates. Skeletal radiographs taken at death revealed 33 fractures, all of which had healed.

9736 **Intrahepatic distribution of plutonium in beagles.** Gearhart, J.M.; Diel, J.H.; McClellan, R.O. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). Contract DE-AC04-76EV01013. *Radiation Research (U.S.);* **84**: No. 2, 343-352(Nov 1980).

Beagle dogs were exposed by inhalation to a $^{238}PuO_2$ aerosol or by intravenous injection to ^{238}Pu or ^{239}Pu-citrate and the distribution of Pu in liver was measured (t = 64-1553 days) after exposure. Random distribution of plutonium at early times after exposure was changed to clustering of activity at times beyond 2 years after inhalation exposure. The distribution of Pu in liver at the cellular level from high levels of Pu exposure was not the same as that at lower levels of exposure such as those most likely to be encountered by man. Particles were found in liver sections of animals that died by 1350 days after exposure by inhalation to a mean initial lung burden of 0.97 μCi/kg body wt. This indicated that for high initial lung burdens, particle transfer can occur. At low levels of exposure, distributions of plutonium deposited in liver after translocation from lung and after intravenous injection were similar for at least 4 months after exposure.

9737 **Influence of a nuclear fuel chemical separations facility on the plutonium contents of a wheat crop.** McLeod, K.W.; Adriano, D.C.; Boni, A.L.; Corey, J.C.; Horton, J.H.; Paine, D.; Pinder, J.E. III. (E.I. du Pont de Nemours and Co., Aiken, SC). Contract EY-76-C-09-0819;AT(07-2)-1. *Journal of Environmental Quality (U.S.);* **9**: No. 2, 306-315(Jun 1980).

Winter wheat (Triticum aestivum) was grown in very close proximity to a nuclear-fuel chemical separations facility to determine the environmental behavior and potential health hazard of chronic low-level releases of plutonium (Pu) to the atmosphere from that facility. The majority (>95%) of the contamination of wheat plants was surfical contamination resulting from direct deposition of recently released Pu-bearing particles onto plant surfaces and resuspension of Pu from soil. Internal contamination resulting from root uptake of Pu was negligible compared to surface contamination. The major pathway (>70%) of Pu to wheat grain was via harvesting activities when Pu was transferred from the surface of vegetative portions of plants to the surface of the grain. Radiation dose resulting from consumption of grain grown in the vicinity of a nuclear-fuel separations facility is negligible compared to that currently received from natural and fallout sources of radiation.

9738 **Use of ^{13}C-phenacetin and ^{13}C-methacetin for the detection of alterations in hepatic drug metabolism.** Schneider, J.F. (Univ. of Chicago, IL); Schoeller, D.A.; Schreider, B.D.; Kotake, A.N.; Hachey, D.L.; Klein, P.D. pp 507-516 of Stable isotopes: proceedings of the third international conference. Klein, E.R.; Klein, P.D. (eds.). New York, NY; Academic Press (1979).

^{14}C-phenacetin, ^{14}C-methacetin, and ^{14}C-dimethyl aminopyrine were administered to rats orally and respiratory CO_2 was collected for timed intervals thereafter. A more rapid production of $^{14}CO_2$ was observed with both methacetin and phenacetin than with amino-pyrine. In 4 normal human subjects, administration of ^{13}C-methacetin resulted in high levels of $^{13}CO_2$ in breath within 15 min. These values showed no overlap with the lower values obtained from 8 subjects with liver disease. The rates of appearance of label from N-demethylation of aminopyrine or from phenacetin O-dealkylation in the same subjects were equivalent for some patients with liver disease and for one normal subject. Smokers had a significantly greater rate of O-dealkylation of methacetin than did non-smokers, but had similar rates of aminopyrine N-demethylation. Because of its more rapid metabolism in normal subjects and its lack of toxicity in small doses, ^{13}C-methacetin may be preferable to aminopyrine for measurement of hepatic microsomal function in man.

9739 **Photosensitization.** Spikes, J.D. (Univ. of Utah, Salt Lake City). pp 87-112 of Science of photobiology. Smith, K.C. (ed.). New York, NY; Plenum Press (1977).

A generalized view of photosensitization is presented in Section 3.8 as an introduction to the subject: the treatment here emphasizes photosensitization in biological systems. Most cells are rather

insensitive to direct effects of visible light, since their major organic constituents do not absorb appreciably in this wavelength range. In the presence of an appropriate photosensitizer, however, organisms, cells, and many types of biologically important molecules can be damaged and destroyed by visible light. Cells are probably killed by selective photochemical effects on certain cell organelles; damage to the organelle results from selective alteration of macromolecules in the organelle, and alteration of the macromolecule results from selective damage to certain of its subunits. Thus, the study of photosensitization in biology ranges from an examination of the photochemistry of excited sensitizer molecules to the photosensitized killing of mammals.

5602 Thermal Effects

9740 **(ANL/ES—108) Automatic underwater radiotelemetry system to monitor temperature responses of fish in a freshwater environment.** Prepejchal, W.; Thommes, M.M.; Spigarelli, S.A.; Haumann, J.R.; Hess, P.E. (Argonne National Lab., IL (USA)). Nov 1980. Contract W-31-109-ENG-38. 74p. NTIS, PC A04/MF A01.

An automated radiotelemetry system developed to monitor body and water temperature of free-swimming fish is described. The receiving and data acquisition unit can be programmed to monitor as many as 16 transmitters (fish); each transmitter can time-multiply data from up to 9 resistive transducers. A typical transmitter with saddle-type attachment, suitable for fish weighing 1 to over 10 kg, has a submerged weight of less than 10 g. The typical range is 2700 m for fish 1 m below the surface. Complete schematics and operational logic are provided for the receiver and data processing printed circuit boards, for 3 types of fish transmitters, and for an environmental parameter monitor. Construction methods, calibration and tagging procedures, and the required computer programs are detailed. This system was in operation for 3 years at the Point Beach Nuclear Power Plant, Two Creeks, Wisconsin. Of the 89 fish tagged, 77 fish provided useable body and water temperature information with tracking times ranging from 0.5 to 505 hours. Modifications which would further improve the system's reliability are discussed.

9741 **(COO—2502-17) Continuation of studies on thermoregulation of fish and turtles in thermally stressed habitats. Annual progress report, 1 October 1979-30 September 1980.** Spotila, J.R. (State Univ. of New York, Buffalo (USA). Dept. of Biology). May 1980. Contract AS02-76EV02502. 44p. NTIS, PC A03/MF A01.

Fundamental and realized climate spaces were calculated for the turtle Chrysemys scripta. These allow predictions about the effect of microclimate and thermal effluents on the behavior of these animals to be made. A conceptual model to define the biophysical-behavioral thermoregulatory mechanisms employed by this turtle is being finalized. Operative environmental temperature (T/sub e/) is a good predictor of the basking behavior of turtles. T/sub e/ is positively related to visible and thermal radiation and air temperature. Turtles generally do not bask until T/sub e/ exceeds 28°C, thus implicating thermoregulation as a major factor in determining the basking behavior of C. scripta. Water temperature was very important in determining the distribution of largemouth bass, Micropterus salmoides, in a South Carolina reservoir receiving thermal effluent from a nuclear reactor. Bass were restricted in movement by lethal water temperatures, selecting temperatures close to 30°C and avoiding temperatures above 31°C. Under normal, unheated conditions, bass dispersed throughout the reservoir. During reactor operation, hot water at temperatures lethal to fish (~ 55°C), forced bass to retreat to refuges in two coves and a deep spring. Distribution of bass varied seasonally. Multichannel radio transmitters were surgically implanted in free ranging fish, permitting the telemetry of temperatures from five parts of the body and from surrounding water. In general, body temperatures followed water temperatures closely, but rapidly changing temperatures produced lags between body temperatures and water of as much as 3.5°C. (ERB)

9742 **(COO—2502-18) Continuation of studies on thermoregulation of fish and turtles in thermally stressed habitats. Summary progress report, 1 October 1977-30 September 1980.** Spotila, J.R. (State Univ. of New York, Buffalo (USA). Dept. of Biology). May 1980. Contract AS02-76EV02502. 34p. NTIS, PC A03/MF A01.

Biophysical-behavioral-ecological models have been completed to explain the behavioral thermoregulation of largemouth bass (Micropterus salmoides) and turtles (Chrysemys scripta). Steady state and time dependent mathematical models accurately predict the body temperatures of largemouth bass. Field experiments using multichannel radio transmitters have provided temperatures of several body compartments of free ranging bass in their natural habitat. Initial studies have been completed to describe the behavioral thermoregulation of bass in a reactor cooling reservoir. Energy budgets, fundamental climate spaces, and realized climate spaces have been completed for the turtle, C. scripta. We have described the behavioral thermoregulation of C. scripta in Par Pond, S.C. and have measured its movements, home ranges and population levels in heated and unheated arms of the reservoir. Operative environmental temperature is a good predictor of the basking behavior of this turtle. A new synthesis explained the evolution of thermoregulatory strategies among animals. Laboratory experiments clarified the effects of movement, diving and temperature on the blood flow of alligators. Other experiments defined the role of boundary layers in controlling the evaporation of water from the surfaces of turtles and alligators in still and moving air. Nutritional status may be an important factor affecting the thermoregulatory behavior of turtles.

9743 **Stress and body condition in a population of largemouth bass: implications for red-sore disease.** Esch, G.W. (Wake Forest Univ., Winston-Salem, NC); Hazen, T.C. Contract AS09-76EY-00900;EY-76-C-09-0819. *Transactions of the American Fisheries Society (U.S.);* **109**: No. 5, 532-536(Sep 1980).

The body conditions, $K = 10^5$(weight, g)/(standard length)^3, and various hematological characters were examined for largemouth bass (Micropterus salmoides) taken from Par Pond, a reservoir heated by effluent from a nuclear production reactor at the Savannah River Plant near Aiken, South Carolina. Largemouth bass with K less than 2.0 had significantly lower ($P < 0.05$) hematocrits, hemoglobin concentrations, total red blood cell counts, total white blood cell counts, and lymphocyte fractions, and significantly higher granulocyte fractions and cortisol concentrations, than those with K greater than 2.0; monocyte, thrombocyte, and reticulocyte fractions were not different between the two K-factor groupings. When data were pooled, all blood variables except the reticulocyte fraction were significantly correlated with K. Hematocrit, the lymphocyte fraction, and cortisol concentration account for 20.5% of the variation in K. These data support a previous hypothesis that elevated water temperature promotes stress. Stress within the Par Pond largemouth bass population may play an important role in the epizootiology of red-sore disease caused by the gram-negative bacterium, Aeromonas hydrophila.

9744 **Climate, health and disease.** Weihe, W.H. (Univ. Hospital, Zurich, Switzerland). pp 313-368 of World climate conference. Geneva, Switzerland; World Meteorological Organization (1979).

From World climate conference; Geneva, Switzerland (12 Feb 1979).

Seasonal prevalence in morbidity and mortality from communicable as well as non-communicable diseases is discussed as a medical-biological problem of the man-climate relationship with definite seasonal variations. 98 references. (PSB)

5603 Chemicals Metabolism And Toxicity

REFER ALSO TO CITATION(S) 8558, 8625, 9644, 9673, 9691, 9703

9745 **(ANL/EES-TM—112) SO_2 dose-response sensitivity classification data for crops and natural vegetation species.** Irving, P.M.; Ballou, S.W. (Argonne National Lab., IL (USA)). Sep 1980. Contract W-31-109-ENG-38. 30p. NTIS, PC A03/MF A01.

Over the past several years studies have been made on the interaction of sulfur dioxide (SO_2) and vegetation by performing field research and by developing analytical procedures for applying field observation data to energy impact assessments. As a result of this work, numerous reports have been prepared on crop-pollutant interactions, such as dose-response data; on the applications of such data to screening approaches for identifying crops at risk; and on models that predict crop yield reductions from point source emissions of SO_2. Data that were used for these studies, such as the crop-at-risk screening procedure, are presented in this report. Maps are also presented that show the national distribution of SO_2-sensitive crops and natural vegetation.

9746 **(DOE/ET/00222—7) Exploratory research on mutagenic activity of coal-related materials. Progress report, September 1-December 1, 1980.** Warshawsky, D.; Schoeny, R. (Cincinnati Univ., OH (USA). Dept. of Environmental Health). 1980. Contract AS22-78ET00222. 14p. NTIS, PC A02/MF A01.

Samples ETTM-01 through ETTM-18 were tested for mutagenicity in Salmonella strain TA1537. Samples previously shown to be non-mutagenic or marginally for TA1538, TA98 and TA100 were not mutagenic for TA1537. Those samples mutagenic for TA1538, TA100 and TA98 were also mutagenic for TA1537 but to a much lesser degree.

9747 **(DOE/EV/03267—18) Improved mutagen-testing systems in mice. Progress report, 1 September 1979-30 October 1980.** Roderick, T.H. (Jackson Lab., Bar Harbor, ME (USA)). 3 Nov 1980. Contract AS02-76EV03267. 12p. NTIS, PC A02/MF A01.

Work is continuing on: chromosomal inversions and Robertsonians; cytology of inversions; translocations; mutagen test validation; meiotic pairing; and the characterization of induced lethals. (PSB)

9748 **(DOE/EV/04384—T1) Comparative evaluation of effects of ozonated and chlorinated thermal discharges on estuarine and freshwater organisms.** Guerra, C.R.; Sugam, R.; Meldrim, J.W.; Holmstrom, E.R.; Balog, G.E. (Public Service Electric and Gas Research Corp., Newark, NJ (USA); Ichthyological Associates, Inc., Middletown, DE (USA)). Aug 1980. Contract AC02-77EV04384. 138p. NTIS, PC A07/MF A01.

As a part of a program at PSE and G designed to examine the feasibility of ozonation as an alternative to chlorination for control of biofouling in once-through cooling systems, the biological effects of ozonated and chlorinated thermal discharges were evaluated with estuarine and freshwater organisms. Mortality at salinities between 0.5 to 2.5 ppt with mummichog and white perch indicated greater toxicity for chlorine while the alewife, spottail shiner, rainbow trout and white perch in freshwater were more sensitive to ozone. Behavioral and physograhic results were consistent with those observed in toxicity studies. Initial cough response and avoidance concentrations of mummicog and white perch in estuarine waters were lower when exposed to chlorine than to ozone. In freshwater, blueback herring, alewife, rainbow trout, spottail shiner, banded killifish, and white perch avoided lower concentrations of ozone than chlorine.

9749 **(DOE/EV/72002—51) Nature and mechanism of induction of mutations. Annual progress report, August 1, 1979-August 1, 1980.** Nilan, R.A.; Kleinhofs, A.; Konzak, C.F. (Washington State Univ., Pullman (USA)). 1 Aug 1980. Contract AT06-76EV72002. 11p. NTIS, PC A02/MF A01.

Past year results have increased understanding of the pathway by which the azide metabolite is synthesized in vivo, the development of a technique for producing an abundant amount of the metabolite in vitro and in furthering the understanding of the effect of azide and its metabolite of chromosomes through analyses of sister chromatid exchanges. Some additional information has been obtained on the chemical nature of the metabolite - specially possible differences of those from barley and from bacteria. Since the final budget was considerably less than requested, research on the chemical nature and identification of the metabolite had to be curtailed. Considerable progress was made on understanding the nature of azide-induced mutations through continued mapping of mutant alleles at the waxy pollen locus and characterization of the gene products and karyotype analysis of these mutant alleles.

9750 **(ORNL/EIS—163/V2-P1) Chemicals identified in human biological media, a data base. Second annual report, October 1980.** Cone, M.V.; Baldauf, M.F.; Martin, F.M.; Ensminger, J.T. (comps.). (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 494p. (EPA—560/13-80-036A). NTIS, PC A21/MF A01.

A comprehensive data base of chemicals identified in human biological media (tissues and body fluids) has been established. Data were obtained primarily from the open literature through manual searches (retrospective to 1974) of the journals listed in Appendix A. The data base now contains information on over 500 different substances. Chemicals are listed by Chemical Abstracts Service (CAS) registry numbers and preferred names in Appendix B. For the user's convenience, cross-referenced chemical lists of CAS names are provided in Appendix C. The human tissues and body fluids found to be contaminated by these chemicals are listed in Appendix D. The data base is published annually in two parts. Part 1 contains introductory materials, references, appendices, indices, and a chemical directory. Information in Part 1 is cumulative, thus allowing the user access to information in the previous edition of Part 2. Data from more than one-third of the over 3000 body-burden documents collected to date have been entered in the data base as of October 1980. The emphasis on inputting recent literature and significant research documents has resulted in a chronological mix of articles from 1974 to the present in the first two publications of the data base.

9751 **(ORNL/EIS—163/V2-P2) Chemicals identified in human biological media, a data base. Second annual report, October 1980.** Cone, M.V.; Baldauf, M.F.; Martin, F.M.; Ensminger, T. (comps.). (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 675p. (EPA—560/13-80-036B). NTIS, PC A99/MF A01.

A comprehensive data base of chemicals identified in human biological media (tissues and body fluids) has been established. This two-part volume is the second annual publication of the data base. Part 2 contains the data base in tabular format and arranged alphabetically by Chemical Abstracts Service (CAS) preferred chemical name. The chemical is given along with its CAS registry number, formula, atomic weight, melting point, boiling point, and vapor pressure. Tissues are listed alphabetically in with the record number.

9752 **(PNL—3474) Chemical, biomedical and ecological studies of SRC-I materials from the Fort Lewis Pilot Plant: a status report.** Mahlum, D.D. (ed.). (Battelle Columbus Labs., OH (USA)). Jan 1981. Contract AC06-76RL01830. 82p. NTIS, PC A05/MF A01.

This document discusses studies performed with solvent refined coal (SRC) materials obtained from the Fort Lewis Pilot Plant during operation in the SRC-I mode. The development of analytical methodology is presented as well as results obtained from the application of these methods to light oil (LO), wash solvent (WS) and process solvent (PS). Results of cellular and animal studies with LO, WS and PS are included, along with a description of methods for the generation and characterization of LO and PS aerosols, and for exposing rats, mice and guinea pigs to these aerosols. The effects of SRC-I product on seed germination and plant growth which have also been studied are discussed. The SRC-I product, feed coal and the mineral residue have been analyzed for organic and inorganic constituents. The higher-boiling-point material, PS, exhibited significant mutagenic activity in the Ames assay; LO and WS were inactive. Process solvent also caused transformation of cultured Syrian hamster embryo cells. Additional chemical fractionation studies suggest that primary aromatic amines are major determinants of the observed mutagenic activity. Skin-painting studies with SRC-II naphtha, heavy distillate, shale oil and petroleum crude indicate a good correlation between the results of the cellular assays and skin carcinogenesis in mice. Wash solvent was more toxic after oral administration to rats than was light oil or process solvent. The effects of LO, WS and PS on development

were studied after administration to pregnant rats. The tissue distribution of a number of components of PS was studied after oral administration of PS to rats. The effect of SRC-I product on the germination and growth of barley was investigated by mixing or layering the product with soil and placing the mixture in a field lysimeter.

9753 **(PNL—3604) Mutagenic and chemical properties of SRC-I materials: a status report.** Pelroy, R.A. (ed.). (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1981. Contract AC06-76RL01830. 33p. NTIS, PC A03/MF A01.

Process solvent (PS) and solid product (dissolved in organic solvent) produced by the Solvent Refined Coal (SRC-I) process at the Wilsonville pilot plant contain mutagenically active components against the Ames-Salmonella strains, Salmonella typhimurium TA98 and TA100. Ames-positive mutagens are apparently concentrated in the moderately polar to strongly polar chemical constituents of both materials. However, the dissolved solid product contains a much higher proportion of very strongly polar mutagens, and may be enriched in acidic - i.e., oxygen-containing mutagens.

9754 **(UCID—18537) Model for forecasting the effects of SO_2 pollution on growth and succession in a western coniferous forest.** Kercher, J.R.; Axelrod, M.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Jan 1981. Contract W-7405-ENG-48. 65p. NTIS, PC A04/MF A01.

A forest succession simulator has been developed for the mixed conifer forest type of the Sierra Nevada, California (seven major species) by extensively modifying a northeastern US simulator. The model simulates growth including the development in time of dbh, height, leaf area index, and available light for each tree. Recruitment and mortality are modeled stochastically. Modificatons include the introduction of fire ecology and the use of temporal seed crop patterns and seedling survival factors unique to Sierra Nevada forests. Pollutant impacts are currently being modeled as an effect on tree growth. The model simulates community dynamical and structural response to many factors quite well. To investigate effects of low level chronic SO_2 fumigation, we set the pollutant level to cause annual leaf area damage of 5% for SO_2-sensitive species and 0.6% in tolerant species. This generates a 10% reduction in growth for P. ponderosa, 18% reduction in growth for Pseudotsuga menzlisii, and approximately 2% to 1% reduction for SO_2 tolerant species such as A. concolor. Time-averaged P. ponderosa basal area decreased 35% and A_1 concolor (SO_2 tolerant) increased by 300% at the 1524 m elevation.

9755 **Mutagenicity of fly ash particles in Paramecium.** Smith-Sonneborn, J. (Univ. of Wyoming, Laramie); Palizzi, R.A.; Herr, C.; Fisher, G.L. *Science (U.S.);* **211**: 180-182(9 Jan 1981).

Paramecium, a protozoan that ingests nonnutritive particulate matter, was used to determine the mutagenicity of fly ash. Heat treatment inactivated mutagens that require metabolic conversion to their active form but did not destroy all mutagenicity. Extraction of particles with hydrochloric acid, but not dimethyl sulfoxide, removed detectable mutagenic activity.

5604 Other Environmental Pollutant Effects

9756 **(AD-A—083316) EMP facilities interaction. Final report, October-December 1979.** Rhine, L.E. (Defense Nuclear Agency, Kirtland AFB, NM (USA)). 1 Mar 1980. 47p. NTIS, PC A03/MF A01.

Electromagnetic Interaction of EMP facilities on Kirtland AFB was investigated and evaluated. Personnel safety from a physiological viewpoint is addressed and energy comparisons made.

9757 **(AD-A—083321) True-integrating environmental noise monitor and sound-exposure level meter. Volume IV. Mechanical construction and electrical check out. Final report.** Averbuch, A.J.; Brown, R. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Mar 1980. 57p. NTIS, PC A04/MF A01.

This volume gives the assembly, adjustment, and checkout procedures necessary to construct a U.S. Army Construction Engineering Research Laboratory (CERL) True-Integrating Environmental Noise Monitor and Sound-Exposure Level Meter. It describes the monitor's mechanical layout, wiring guidelines, adjustments to components to bring various circuits into tolerance, and steps for verifying the correct operation of the monitor. Also included are test programs to be executed by the internal microprocessor to exercise the internal circuit to help checkout or repair.

9758 **(AD-A—083571) Tissue culture modelling of microwave induced cataracts of the eye lens. Annual summary report, 1 September 1978-31 August 1979.** Trevithick, J.R. (University of Western Ontario, London (Canada). Dept. of Biochemistry). Aug 1979. 15p. NTIS, PC A02/MF A01.

Intact rat lenses incubated in Medium 199 (M199) at 35.5 maintain their transparency for at least 9 days. When heated to various temperatures for 1 hour to model cataractogenesis by elevated temperatures, followed by 47 hours at 35.5 C, some lenses developed cataractous opacities, depending on the temperature of incubation. At 39 C slight globular degeneration of fiber cells appeared, localized in the equatorial region, with globules up to 20 microns in diameter as has been reported for glucose-induced cataracts. At 41 C the globular degeneration was deeper at the equatorial region, extending towards the nucleus and extended to the anterior and posterior of the lens. At 47 C and 50 C some very large globules were formed (ca 200 microns across) and the globular degeneration was more extensive. At higher temperatures (60 C) lenses did not become opaque. They had normal transparency and acuity, perhaps because they had been fixed, by a process similar to histological fixation. The morphological appearance of such lenses examined by scanning electron microscopy (SEM) was normal. D-alpha-tocopherol acetate (Vitamin E) when added to lenses before incubation at 41 C, prevented the globular degeneration observed at this temperature. These results indicate that the intact rat lens in M199 appears much more sensitive to elevation in temperature than does the lens in vivo.

9759 **(AD-A—084828) MILES device: ocular hazard evaluation. Interim report, 1 May-30 September 1979.** Zuclich, J.A.; Tredici, T.J.; Mikesell, G.W. Jr.; Gibbons, W.D.; Schmidt, R.E. (Technology, Inc., San Antonio, TX (USA). Life Sciences Div.). Mar 1980. Contract F33615-77-C-0615. 10p. NTIS, PC A02/MF A01.

This report describes an attempt to find ocular effects in the primate eye as a result of exposure to a MILES (Multiple Integrated Laser Engagement System) laser transmitter for a M16A1 rifle. The MILES device incorporates a pulsed gallium arsenide laser operating in the near infrared. For the exposure parameters reported, no ocular alterations could be detected with either a fundus camera or a direct ophthalmoscope.

9760 **(AD-A—085082) Electromagnetic energy deposition in a concentric spherical model of the human or animal head. Interim report, January-September 1977.** Bell, E.L.; Cohoon, D.K.; Penn, J.W. (School of Aerospace Medicine, Brooks AFB, TX (USA)). Dec 1979. 98p. NTIS, PC A05/MF A01.

A five-spherical layer plus core sphere, approximating the human or animal head, is exposed to plane wave, nonionizing electromagnetic radiation. The resulting induced fields within the simulated cranial structure are used in calculating the internal absorbed-power density distributions, average absorbed-power density, and total absorbed power. The mathematical theory and formulas basic to accomplishing the computations are discussed in depth. Calculation requirements encountered are implemented in the form of a computer program. Discussion of this users-oriented program covers such details as: structure and sequence of control parameter and data cards, output formats, and subroutine and function subprograms. Sample printouts and plots (linear and contour) of computer results and a listing of the FORTRAN source program are included.

57 HEALTH AND SAFETY

9761 (BNL—28747) Major parameters affecting temperature inside inhalation chambers. Bernstein, D.M.; Drew, R.T. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract AC02-76CH00016. 22p. (CONF-7810255—1). NTIS, PC A02/MF A01.

From Inhalation chamber technology conference; Upton, NY, USA (16 Oct 1978).

These studies showed that stainless steel chamber walls were very effective at removing heat from an (380 l) inhalation chamber. Cooling the incoming air was not as effective in cooling the stainless steel chamber, because most of the heat transfer from the animals in the chamber was by thermal radiation and the cooled intake air was rapidly heated through the chamber wall by the surrounding room environment. With the chamber air supply at room temperature, heat transfer through noninsulated stainless steel walls was effective in removing ~ 90% of the heat generated by the animals as compared to only 10% removed by the airstream at 100 l/min. It is important that design engineers be aware of the relatively large percentage of cooling that takes place as the result of heat transfer to and from the chamber surfaces. With low flow rates, the heat transfer to the surrounding environment can be increased when necessary by painting the chambers (independent of color), thereby maximizing the emissivity of the stainless steel, by attaching cooling fins or cooling coils to the chamber walls, or by directing the room air conditioning ducts directly onto the chamber. In situations where suitably higher amounts of toxin can be used, the airflow through the chamber can be increased to augment removal of the heat generated by the animals. This study also indicated that by measuring an effective heat transfer coefficient for a chamber one can determine for specific flow rates the maximum room temperature permissible to maintain a reasonable chamber temperature with varying animal loadings.

9762 (DOE/ET/13650—5) Occupational safety and health training program at ETCs. Interim status report. Meyer, A.F. Jr.; Vaudreuil, M.; Wisniewski, S.T. (Meyer (A.F.) and Associates, Inc., McLean, VA (USA)). Jan 1981. Contract AM01-80ET13650. 9p. NTIS, PC A02/MF A01.

Preliminary studies reveal that serious deficiencies exist in occupational safety and health training programs within DOE's fossil fuel programs. The basic requirements of Executive Order 12196, 29 CFR 1960 (both earlier and current versions) and Chapter III, ASFE 5480.1 are not being addressed in an adequate fashion. The principal deficiencies are a lack of sufficient funding for both employee and safety and health staff training, and inadequate or non-existent documentation of training for top management, intermediate levels of management, and supervisors. Similar deficiencies exist in varying degrees for other employees. It is apparent that the full extent of the training requirements in OSHA 29 CFR 1910 standards has not been recognized and implemented within the ETCs.

9763 (SAND—80-2812) Special Projects Division. Quarterly progress report, 1 October-31 December 1980. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 30p. NTIS, PC A03/MF A01.

Thirteen of a final number of fifteen guidance documents, designed to facilitate implementation of environment, safety, and health (ES and H) assurance programs, are now complete in draft form. Completed in draft form this quarter were Model Guidelines for Safety Assessment in ES and H Assurance Programs and Model Institutional Accident Investigation Guidelines. Three of the remaining four user menus for the ES and H Assurance Program Information System were completed this quarter. Menus which permit the user to ask for specific system outputs, add to, delete, or change the system's vocabulary, and add to, delete, or change decision criteria were finished this quarter. A method was developed for capturing user-specific ES and H Assurance Program criteria for information system input, and a preliminary version of candidate criteria for administrative plans was completed. In addition, draft data collection procedures and forms were devised.

9764 Federal regulation of PCB's under the Toxic Substances Control Act. DeKany, J.P.; Sibold, L.P. Washington, DC; Environmental Protection Agency (1980). 11p. (CONF-800264—13). American Public Power Association, Washington, DC.

From 24. American Public Power Association annual engineering and operations workshop; Phoenix, AZ, USA (25 Feb 1980).

The role of the Environmental Protection Agency (EPA) in the control of polychlorinated biphenyls (PCBs) is reviewed. Plans for disposal of PCB's by incineration in high-efficiency boilers are discussed. A plea is made to members of the utility industry to replace voluntarily PCB capacitors and transformers if available storage facilities are available. (JGB)

58 GEOSCIENCES

5801 Geology And Hydrology

9765 (LA—8635-MS) Geohydrology of White Rock Canyon of the Rio Grande from Otowi to Frijoles Canyon. Purtymun, W.D.; Peters, R.J.; Owens, J.W. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 17p. NTIS, PC A02/MF A01.

Twenty-seven springs discharge from the Totavi Lentil and Tesuque Formation in White Rock Canyon. Water generally acquires its chemical characteristics from rock units that comprise the spring aquifer. Twenty-two of the springs are separated into three groups of similar aquifer-related chemical quality. The five remaining springs make up a fourth group with a chemical quality that differs due to localized conditions in the aquifer. Localized conditions may be related to recharge or discharge in or near basalt intrusion or through faults. Streams from Pajarito, Ancho, and Frijoles Canyons discharge into the Rio Grande in White Rock Canyon. The base flow in the streams is from springs. Sanitary effluent in Mortandad Canyon from the treatment plant at White Rock also reaches the Rio Grande.

9766 (RHO-BWI-LD—26) Assessment of the effects of existing major dams upon a radioactive waste repository within the Hanford Site. Leonhart, L.S. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Jun 1980. Contract AC06-77RL01030. 58p. NTIS, PC A04/MF A01.

An examination has been made of existing and proposed radioactive waste disposal criteria with respect to evaluation of the effects of dams and impoundments on proposed facilities. Principal documents were surveyed. The relevant criteria extracted from these documents include considerations related to: the effects of flooding during the repository operation phase; the alteration of the groundwater flow regime during post-impoundment re-equilibration; and reservoir-induced seismic activity. This report briefly discusses our current state of knowledge with respect to the above considerations, based on available literature and data for the Hanford Site.

9767 (SAND—80-1102) Basic data report for drillhole WIPP 32 (Waste Isolation Pilot Plant - WIPP). (Sandia National Labs., Albuquerque, NM (USA); Geological Survey, Denver, CO (USA)). Nov 1980. Contract AC04-76DP00789. 73p. NTIS, PC A04/MF A01.

WIPP 32 is an exploratory borehole drilled to examine the subsurface at a small topographic high in Nash Draw. The borehole is located in east-central Eddy County, New Mexico, in NE 1/4 SE 1/4 Sec. 33, T.22S., R.29E. and was drilled in August, 1979. The hole was drilled to a depth of 390 feet, and encountered, from top to bottom, the Rustler Formation (166') and the upper Salado Formation (224'). Core was taken from 4 to 353 feet. Geophysical logs were run the full length of the hole to measure formation properties. The WIPP is to demonstrate (through limited operations) disposal technology for transuranic defense wastes. The WIPP will also provide facilities to research interactions between high-level waste and salt.

5802 Geophysics

REFER ALSO TO CITATION(S) 9451, 9766

9768 (JAB—00099-120) Probable earthquake ground motion as related to structural response in Las Vegas, Nevada. Greensfelder, R.W.; Kintzer, F.C.; Somerville, M.R. (URS/John A. Blume and Associates, Engineers, San Francisco, CA (USA)). Dec 1980. Contract AC08-76DP00099. 140p. NTIS, PC A07/MF A01.

Ground motion parameters are necessary for structural damage assessments and dynamic effects prediction in Las Vegas, Nevada. To develop these, a model of tectonic activity in the southern Basin and Range province was constructed on the basis of late Cenozoic patterns of crustal deformation, estimates of regional strain rates in Holocene time, and historic seismicity. From this information, the region surrounding Las Vegas was subdivided into six seismotectonic zones. Historic seismicity was analyzed on the basis of seismographically recorded earthquakes and compared with long-term seismotectonic activity. Apparent agreement between the two sets of data indicates that the average rates of historic seismicity observed in the areas analyzed are reasonably representative of long-term seismicity. Magnitude-recurrence relationships were developed for each of the six seismotectonic zones, and probable maximum values of peak ground acceleration in Las Vegas were calculated using a computer program (HAZARD) developed for the study. Probable causative earthquake magnitudes in each source zone, probable values of duration of seismic shaking, and predominant periods likely to be associated with various peak accelerations were also determined.

9769 (LA—8614-PR) Earthquake catalog for northern New Mexico. Progress report, April-June 1980. Wechsler, D.J.; Cash, D.J.; Olsen, K.H.; McFarland, N.J.; Wolff, J.J. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 15p. NTIS, PC A02/MF A01.

This report is a summary of northern New Mexico earthquakes located by the Los Alamos Scientific Laboratory seismic array. Data are presented in the form of tables and epicenter maps, with a brief explanatory text.

9770 (LA—8687-PR) Earthquake catalog for northern New Mexico. Progress report, July-September 1980. Wechsler, D.J.; Cash, D.J.; Olsen, K.H.; McFarland, N.J.; Wolff, J.J. (Los Alamos Scientific Lab., NM (USA)). Jan 1981. Contract W-7405-ENG-36. 15p. NTIS, PC A02/MF A01.

This report is a summary of the earthquakes in northern New Mexico located by the Los Alamos National Laboratory seismic array. Data are presented in the form of tables and epicenter maps, with a brief explanatory text.

9771 (UCRL—53072) Seismic waves in horizontally stratified half-space. Thigpen, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Nov 1980. Contract W-7405-ENG-48. 35p. NTIS, PC A03/MF A01.

The reflectivity method for computing synthetic seismograms as developed by Fuchs and Mueller and extended by Kennett is modified to include both body and surface waves from a buried source in a layered half-space. Some details of the general method are presented. The vertical displacements are computed for various structures at different source locations to elucidate numerical difficulties encountered with the reflectivity method. Portions of the seismograms are interpreted in terms of reflected, refracted, and surface waves.

5803 Mineralogy, Petrology, And Rock Mechanics

9772 (DP—1559) Review of potential host rocks for radioactive waste disposal in the southeastern United States. Executive summary. Bledsoe, H.W. Jr.; Marine, I.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Oct 1980. Contract AC09-76SR00001. 92p. NTIS, PC A05/MF A01.

The geology of the southeastern United States was studied to recommend areas that should be considered for field exploration in order to select a site for a radioactive waste repository. The region studied included the Piedmont Province, the Triassic Basins, and the Atlantic Coastal Plain in Maryland, Virginia, North Carolina, South Carolina, and Georgia. This study was entirely a review of literature and existing knowledge from a geotechnical point of view and was performed by subcontractors whose individual reports are listed in the bibliography. No field work was involved. The entire study was geotechnical in nature, and no consideration was given to socioeconomic or demographic factors. These factors need to be addressed in a separate study. For all areas, field study is needed before any area is further considered. A total of 29 areas are recommended for further consideration in the Piedmont Province subregion: one area in Maryland, 8 areas in Virginia, 4 areas in North Carolina, 6 areas in South Carolina, and 10 areas in Georgia. Of the 14 exposed and 5 buried or hypothesized basins identified in the Triassic basin subregion, 6 are recommended for further study: one basin in Virginia, 3 basins in North Carolina, and 2 basins in South Carolina. Four potential candidate areas are identified within the Atlantic Coastal Plain subregion: one in Maryland, one in North Carolina, and 2 in Georgia.

9773 (DP—1561) Review of potential host rocks for radioactive waste disposal in the Piedmont Province of Virginia and Maryland. Brown, W.R. (Kentucky Univ., Lexington (USA). Dept. of Geology; Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Oct 1980. Contract AC09-76SR00001. 102p. NTIS, PC A06/MF A01.

This study is a detailed follow-up of a broad study of the Southeastern Piedmont by Acres American, Inc. (1978) based upon literature and existing knowledge. The purpose is to designate broad areas in which the rock type is favorable for field exploration for the possible designation of a site for disposal of solidified radioactive waste. The Acres study classified rock units as favorable, potentially favorable, and unfavorable. The objective of the present study is: (1) to review the criteria used in this classification, and (2) on the basis of a detailed knowledge of local rock units to reassign the rock types in the potentially favorable category to either the favorable or the unfavorable categories. As in the Acres study, the objective is to designate field study areas, not potential sites. This study was based entirely upon a literature study, discussions with persons knowledgeable of the region, and a personal acquaintance with the rocks and structures. No field work was done specifically for this project. No consideration was given to sociological, economic, or non-technical factors.

9774 (DP—1563) Review of potential host rocks for radioactive waste disposal in the Piedmont Province of South Carolina. Secor, D.T. Jr. (South Carolina Univ., Columbia (USA). Dept. of Geology; Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Oct 1980. Contract AC09-76SR00001. 65p. NTIS, PC A04/MF A01.

This report reviews the geology of the Piedmont Province of South Carolina with the aim of designating rock units favorable for field exploration for a potential underground repository for the storage of radioactive waste. Most of the rocks in the South Carolina Piedmont are metamorphosed sedimentary volcanic or igneous rocks that have experienced at least one episode of strong deformation. As a consequence of this deformation, they have irregular shapes, making it difficult to predict their subsurface extent. In evaluating the suitability of the rock units for radioactive waste storage, certain criteria were found to be particularly useful. The requirements that the storage site be located in a large volume of homogeneous, impermeable, relatively unfractured rock was the most important criteria in eliminating most of the Piedmont rock units for consideration as field study areas. Six large late- to post-tectonic igneous plutons (Winnsboro, Liberty Hill, Ogden, Newberry, Lowrys, and Bald Rock) are recommended as field study areas.

9775 (DP—1567) Review of potential host rocks for radioactive waste disposal in the southeast United States-Southern Piedmont subregion. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Oct 1980. Contract AC09-76SR00001. 140p. NTIS, PC A07/MF A01.

A literature study was conducted on the geology of the Southern Piedmont province in the states of Maryland, Virginia, North Carolina, South Carolina, and Georgia. The purpose was to identify geologic areas potentially suitable for containment of a repository for the long-term isolation of solidified radioactive waste. The crystalline rocks of the Southern Piedmont province range in age from Precambrian to Paleozoic, and are predominantly slates, phyllites, argillites, schists, metavolcanics, gneisses, gabbros, and granites. These rock units were classified as either favorable, potentially favorable, or unfavorable as potential study areas based on an evaluation of the geologic, hydrologic, and geotechnical characteristics. No socio-economic factors were considered. Rocks subjected to multiple periods of deformation and metamorphism, or described as highly fractured, or of limited areal extent were generally ranked as unfavorable. Potentially favorable rocks are primarily the high-grade metamorphic gneisses and granites. Sixteen areas were classified as being favorable for additional study. These areas are primarily large igneous granite plutons as follows: the Petersburg granite in Virginia; the Rolesville-Castallia, Churchland, and Landis plutons in North Carolina; the Liberty Hill, Winnsboro, and Ogden plutons in South Carolina; and the Siloam, Elberton, and six unnamed granite plutons in Georgia.

9776 **(DP—1568) Review of potential host rocks for radioactive waste disposal in the southeast United States: Southeastern Coastal Plain Subregion.** (Ebasco Services, Inc., New York (USA)). Oct 1980. Contract AC09-76SR00001. 221p. NTIS, PC A10/MF A01.

A literature review was made of the geological characteristics of the Southeastern Coastal Plain physiograhic province in the states of Maryland, Virginia, North Carolina, South Carolina, and Georgia. The purpose of this study was to identify candidate exploration areas for the possible location of a mined repository for the storage of radioactive waste in the argillaceous sedimentary rocks of the Coastal Plain. Candidate areas were selected on the basis of geological characteristics, available subsurface data, and generally accepted requirements for waste isolation developed by previous studies. Factors considered in the evaluation include the stratigraphy and lithology, geologic history, structure, seismicity, hydrogeology, and natural resources of the candidate area. Unlike other potential regions, the Southeastern Coastal Plain is not composed of competent rock, but consists primarily of unconsolidated and water-saturated sediments overlying a basement of crystalline and metavolcanic rocks. Thus, construction of both shafts and tunnels to depths of ~ 1000 meters may encounter difficulties. Socio-economic and construction considerations have not been addressed in the evaluation. Based on the applied criteria, four areas were selected as being most favorable for future field investigation. These include one in Maryland, one in North Carolina, and two in Georgia (extensive bibliography).

9777 **(RHO-BWI—C-90) Thermal and mechanical properties of Hanford basalts compilation and analysis.** Schmidt, B.; Daly, W.F.; Bradley, S.W.; Squire, P.R.; Hulstrom, L.C. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Oct 1980. Contract AC06-77RL01030. 213p. NTIS, PC A10/MF A01.

Thermomechanical properties of Umtanum flow basalt are essential for further analyses and design of a nuclear waste repository at Hanford, now planned to be placed within the Umtanum flow. The properties of Pomona Member basalt are essential for the analysis of data from the Near-Surface Test Facility (NSTF) at Gable Mountain. This report presents a compilation and analysis of all thermomechanical laboratory data from Hanford basalts and a summary of data for use in analyses involving Umtanum or Pomona basalts. Umtanum flow basalt is essentially similar to basalts of other flows of the Grande Ronde Formation, of which the Umtanum Flow is a member. However, Umtanum flow basalt is lighter and weaker than the younger Pomona Member basalt. Correlations and analyses herein indicate the relationship between the two basalts and suggest how extrapolation from one to the other may be accomplished. Thermal tests are affected by details of testing procedure. Differences between Umtanum and Pomona thermal properties are relatively small. Both thermal and mechanical properties are affected by sampling procedures and by sample selection procedures. The shallower Pomona samples are inherently likely to be of better quality, and the deeper Umtanum samples are likely to underestimate parameters such as strength, modulus, or thermal expansion coefficient. Strength data for samples classified as intact show great scatter; Umtanum shows greater scatter than Pomona. Strength testing of Pomona was performed on samples that were essentially flawless. A large number of specimens for strength testing of Umtanum were picked from limited core lengths, resulting in the testing of many samples with flaws. The data examined herein apply to intact rocks and to joints only.

9778 **(SAND—80-1323) Strategic Petroleum Reserve (SPR) geological summary report, Weeks Island salt dome.** Ortiz, T.S. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1980. Contract AC04-76DP00789. 54p. NTIS, PC A04/MF A01.

A portion of the Weeks Island Salt Dome in southern Louisiana has been purchased by the Department of Energy for the Strategic Petroleum Reserve Program. The complex will be a crude oil storage facility converted from a conventional underground salt mine. This summary of the geotechncal investigations undertaken by several organizations discusses site geology, material properties of the salt, the condition of the oil storage area, the status of other activities in the salt dome, and recommendations.

9779 **(SAND—80-1331) Second benchmark problem for WIPP structural computations.** Krieg, R.D.; Morgan, H.S.; Hunter, T.O. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1980. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01.

This report describes the second benchmark problem for comparison of the structural codes used in the WIPP project. The first benchmark problem consisted of heated and unheated drifts at a depth of 790 m, whereas this problem considers a shallower level (650 m) more typical of the repository horizon. But more important, the first problem considered a homogeneous salt configuration, whereas this problem considers a configuration with 27 distinct geologic layers, including 10 clay layers - 4 of which are to be modeled as possible slip planes. The inclusion of layering introduces complications in structural and thermal calculations that were not present in the first benchmark problem. These additional complications will be handled differently by the various codes used to compute drift closure rates. This second benchmark problem will assess these codes by evaluating the treatment of these complications.

9780 **(SAND—80-1418) Material constitutive model for jointed rock mass behavior.** Thomas, R.K. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 67p. NTIS, PC A04/MF A01.

A material constitutive model is presented for jointed rock masses which exhibit preferred planes of weakness. This model is intended for use in finite element computations. The immediate application is the thermomechanical modelling of a nuclear waste repository in hard rock, but the model seems appropriate for a variety of other static and dynamic geotechnical problems as well. Starting with the finite element representations of a two-dimensional elastic body, joint planes are introduced in an explicit manner by direct modification of the material stiffness matrix. A novel feature of this approach is that joint set orientations, lengths and spacings are readily assigned through the sampling of a population distribution statistically determined from field measurement data. The result is that the fracture characteristics of the formations have the same statistical distribution in the model as is observed in the field. As a demonstration of the jointed rock mass model, numerical results are presented for the example problem of stress concentration at an underground opening.

9781 **(SAND—80-1453) Rock mechanics properties of volcanic tuffs from the Nevada Test Site.** Olsson, W.A.; Jones, A.K. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 43p. NTIS, PC A03/MF A01.

Uniaxial and triaxial compression tests at constant strain-rate were run on samples of volcanic tuff from hole UE25A No. 1 and from G-tunnel, both on the Nevada Test Site. The test results show that the degree of welding, reflected in the porosity, is the dominant variable affecting strength and modulus. The presence of

water, decreased strain-rate, and elevated temperatures can cause reduced strength under some experimental conditions. The coefficient of friction for sawcuts was found to be 0.59 for the Prow Pass member.

9782 (UCRL—85231) Permeability testing of fractures in climax stock granite at the Nevada Test Site. Murray, W.A. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 1980. Contract W-7405-ENG-48. 22p. (CONF-8009124—1). NTIS, PC A02/MF A01.

From Repository sealing field testing workshop; Santa Fe, NM, USA (18 Sep 1980).

Permeability tests conducted in the Climax stock granitic rock mass indicate that the bulk rock permeability can be highly variable. If moderately to highly fractured zones are encountered, the permeability values may lie in the range of 10^{-4} to 10^{-1} darcies. If, on the other hand, only intact rock or healed fractures are encountered, the permeability is found to be less than 10^{-9} darcies. In order to assess the thermomechanical effect on fracture permeability, discrete fractures will be packed off and tested periodically throughout the thermal cycle caused by the emplacement of spent nuclear fuel in the Climax stock.

9783 Effect of Pressure and Stress on Water Transport in Intact and Fractured Gabbro and Granite. Trimmer, D.; Bonner, B.; Heard, H.C.; Duba, A. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Geophysical Research (U.S.);* **85**: No. B13, 7059-7071(10 Dec 1980).

New laboratory data are reported on the effect of confining pressure (to 60 MPa), pore-water pressure (to 30 MPa), and stress difference (to 0.88 of the fracture stress) on permeability of intact and fractured White Lake gneissic granite. Westerly granite, and Creighton gabbro. Permeabilities as low as 10^{-24} m^2 (10^{-2} darcy) have been measured using a transient technique. Fracture displacement, electrical conductance, compressional velocity, and pulse amplitude are determined simultaneously. The loads applied to the 0.15-m-diameter by 0.28-m-length test sample are controlled automatically, and most data are taken by microprocessor. Tests on the intact gneissic granite indicated permeabilities of 10^{-22} to 10^{-24} m^2 that appeared to be unaffected either by effective pressure or by stress. The granite yielded permeabilities of 4 +- 10^{-20} m^2 that decreased by a factor of 2 as effective pressure increased to 25 MPa and varied by a factor of 2 as stress was increased to 0.5 of the fracture stress. Permeability of the gabbro linearly decreased from 2 x 10^{-22} to 8 x 10^{-24} m^2 with effective pressures to 25 MPa. Loading of the gabbro up to 0.88 of the fracture stress increased permeability by a factor of 7. The introduction of a throughgoing fracture increased the apparent permeability by 10^6 to 10^9 over the intact values in both granite and gabbro. When compared to the initial value, compressional velocities increased by 5% with pressure to 30 MPa in the gneissic granite. For granite, pressurization from 2 to 25 MPa increased the velocity and pulse amplitude by 5 and 30%, and decreased the conductance by 50%. Velocity, amplitude, and conductance were weakly dependent on pressure in gabbro. The addition of stress decreased velocity and amplitude while increasing conductance markedly on both granite and gabbro. All data on both intact and fractured rock are consistent with crack closure and dilatancy with pressure and stress.

5804 Geochemistry

REFER ALSO TO CITATION(S) 9646, 9678

9784 Computer-controlled scanning monochromator for the determination of 50 elements in geochemical and environmental samples by inductively coupled plasma-atomic emission spectrometry. Floyd, M.A.; Fassel, V.A.; D'Silva, A.P. (Iowa State Univ., Ames). *Analytical Chemistry (U.S.);* **52**: No. 13, 2168-2173(Nov 1980).

The application of a computer-controlled, scanning monochromator to the determination of 50 elements in geochemical and environmental matrices is described. The monochromator is combined with an inductively coupled plasma excitation source so that elements at major, minor, and trace levels may be determined in sequence without changing experimental parameters other than the spectral line observed. A single set of spectral lines was found to be applicable to a broad range of sample compositions and to show negligible spectral interferences regardless of the sample matrix. 3 figures, 6 tables.

5805 Oceanography

9785 Model and observations of time-dependent upwelling over the mid-shelf and Slope. Janowitz, G.S.; Pietrafesa, L.J. (Department of Marine Science and Engineering, North Carolina State University, Raleigh 27650). A509-76-EY00902. *Journal of Physical Oceanography (U.S.);* **10**: No. 12, 1574-1583(Dec 1980).

A simple model of time-dependent quasi-geostrophic upwelling over an outer continental shelf and slope region is considered with the velocity assumed independent of the alongshore coordinate. The flow is at rest and stably stratified when a uniform alongshore wind stress tau is applied. Initially, the onshore flow in the water column balances the offshore top Ekman volume flux. As time progresses the bottom Ekman layer supplied increasingly more of the required onshore flux and the onshore flow in the interior of the water column decreases. The shallower water spins up first leading to both a coastal jet and an upward bulge in the isopycnal surfaces which propagates offshore with a speed equal to 0.012(tau/p)/sup 1/2/h/sub x/, where h/sub x/ is the local slope. At the shelf break, if h/sub x/xh/h/sub x/^{2}>2 another upward bulge of the isopycnal surfaces will develop at the onset of upwelling favorable winds and will be of greater amplitude than the propagating bulge. The theory is generalized to include the effects of a time-dependent wind stress and those of a specified time-dependent alongshore pressure gradient. The velocity induced by the deformation of the density field is then calculated. Comparisons of theory with moored meter data collected in Onslow Bay, North Carolina are made during upwelling favorable summertime wind conditions.

9786 Numerical study of loop current intrusions and eddy shedding. Hurlburt, H.E.; Thompson, J.D. (Environmental Simulation Branch, Naval Ocean Research and Development Activity, NSTL Station, MS 39529). *Journal of Physical Oceanography (U.S.);* **10**: No. 12, 1611-1651(Dec 1980).

The dynamics of the eddy shedding by the Loop Current in the Gulf of Mexico have been investigated using three nonlinear numerical models: two-layer, barotropic and reduced gravity. The barotropic and reduced gravity models demonstrate the individual behavior of the external and internal modes, and provide insight into how they interact in the two-layer model. Because of the economy of the semi-implicit free surface models, it was possible to perform over 100 experiments to investigate the stability properties of the Loop Current. Typically, the models were integrated 3—5 years to statistical equilibrium on a 1600 km x 900 km rectangular domain with a resolution of 20 km x 18.75 km. Prescribed inflow through the model Yucatan Channel was compensated by outflow through the Florida Straits.

64 PHYSICS RESEARCH

6401 Astrophysics And Cosmology

9787 (AD-A—083501) The rotation of the Sun: observations at Stanford. Technical report. Scherrer, P.H.; Wilcox, J.M.; Svalgaard, L. (Stanford Univ., CA (USA). Inst. for Plasma Research). Feb 1980. Contracts N00014-76-C-0207;NAS5-24420. 34p. NTIS, PC A03/MF A01.

Measurements of the photospheric rotation rate using the Doppler effect have been the subject of controversy since they were first made and have recently been reviewed. Daily observations at the Stanford Solar Observatory have been made since 1976. Analysis of the 950 full-disk low-resolution dopplergrams made to date yields results that conflict with some other recent sets of observations. The SSO observations show no daily or long period variations in the rotation rate that exceed observational error, and the average rate is about the same as that of large-scale magnetic field structures and sunspots. These conclusions are apparently in-

consistent with the well-known results of Howard and Harvey (1970).

9788 **(AD-A—084751) Physics of flares: analysis of simultaneous h alpha and x-ray observations. Final report, 1 February 1977-30 September 1979.** Zirin, H.; Moore, R.L. (California Inst. of Tech., Pasadena (USA). Solar Astronomy Group). 30 Dec 1979. Contract F19628-77-C-0106. 18p. NTIS, PC A02/MF A01.

The results of flare research supported by this contract are reviewed. From analyses of optical, x-ray and microwave observations, significant results bearing on the physics of flares were obtained in three areas: (1) flash phase of flares, (2) thermal phase of flares, and (3) magnetic field configuration and reconnection in flares. The results demonstrate the power of combined analysis of simultaneous high-resolution visible, microwave and x-ray observations for probing the physics of flares. With support from our continuing AFGL contract, we plan to further probe the physics of flares through analysis of many additional flares with high quality simultaneous optical, microwave and x-ray observations which will be obtained over the next few years through the maximum of the present cycle of solar activity.

9789 **(DOE/TIC—11391) Nucleosynthesis of neutron-rich heavy nuclei during explosive helium burning in massive stars.** Blake, J.B.; Woosley, S.E.; Weaver, T.A.; Schramm, D.N. (Aerospace Corp., El Segundo, CA (USA)). 1 Jan 1981. Contract W-7405-ENG-48. 26p. (ATR—81(8454)-2). Aerospace Corporation, El Segundo, CA.

The production of heavy nuclei during explosive helium burning has been calculated using a hydrodynamical model of a 15 M/sub sun/ (Type II) supernovae and a n-process nuclear reaction network. The resulting neutron-rich heavy nuclei are not produced in the relative abundances of solar-system r-process material, especially in the vicinity of Pt, nor are any actinides produced. These deficiencies reflect an inadequate supply of neutrons. However, some neutron-rich isotopes, normally associated with the r-process, are produced which may be significant for the production of isotopic anomalies in meteorites.

9790 **Charge transfer in astrophysical shocks.** Butler, S.E.; Raymond, J.C. (Harvard-Smithsonian Center for Astrophysics). EY-76-5-02-2887. *Astrophysical Journal, The (U.S.);* **240**: No. 2, 680-684(1 Sep 1980).

The effects of charge transfer reactions upon astrophysical shocks are investigated. The column densities, line intensities, and line ratios of the important ionic species of N, O, Si, and S are substantially modified for both low- and high-velocity shocks. Some general implications for shock models of astronomical objects are discussed.

9791 **Inflationary universe: A possible solution to the horizon and flatness problems.** Guth, A.H. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515. *Physical Review, The, D. Particles and Fields (U. S.);* **23**: No. 2, 347-356(15 Jan 1981).

The standard model of hot big-bang cosmology requires initial conditions which are problematic in two ways: (1) The early universe is assumed to be highly homogeneous, in spite of the fact that separated regions were causally disconnected (horizon problem); and (2) the initial value of the Hubble constant must be fine tuned to extraordinary accuracy to produce a universe as flat (i.e., near critical mass density) as the one we see today (flatness problem). These problems would disappear if, in its early history, the universe supercooled to temperatures 28 or more orders of magnitude below the critical temperature for some phase transition. A huge expansion factor would then result from a period of exponential growth, and the entropy of the universe would be multiplied by a huge factor when the latent heat is released. Such a scenario is completely natural in the context of grand unified models of elementary-particle interactions. In such models, the supercooling is also relevant to the problem of monopole suppression. Unfortunately, the scenario seems to lead to some unacceptable consequences, so modifications must be sought.

9792 **Parker spiral configuration of the interplanetary magnetic field between 1 and 8.5 AU.** Thomas, B.T.; Smith, E.J. (Jet Propulstion Laboratory, California Institute of Technology, Pasadena, California 91103). *Journal of Geophysical Research (U.S.);* **85**: No. A12, 6861-6867(1 Dec 1980).

An analysis is presented of the magnetic field data obtained by the Pioneer 10 and 11 spacecraft. The purpose is to provide a quantitative picture of the overall configuration of the interplanetary magnetic field in the outer heliosphere. The field directions observed between 1 and 8.5 AU are found, on average, to conform to the Parker spiral directions within both quiet regions and interaction regions to an overall accuracy of 1.1 °. The average latitude angle of the field is shown to be zero within a similar accuracy. The included angle between the inward and ourward sectored field directions is found to be very close to 180 ° and displays no solar cycle dependent trends, such as have been previously reported. The field direction is shown to display greater variability in quiet regions than in interaction regions, a fact which is important in terms of the effect of interaction regions on the propagation of energetic particles. The fractional polarities for observations below 10 ° heliographic latitude are shown to be dominated by temporal variations; however, dual-spacecraft studies have allowed a significant latitudinal gradient to be extracted. This result is qualitatively consistent with the almost complete disappearance of the inward sector at 16 ° heliographic latitude, although it is suggested that the latter effect may be due to a lower than average current sheet inclination in 1976. The sector structure is shown to extend occasionally to these high latitudes during this time, implying a defection of the equatorial current sheet, in association with individual interaction regions. It is suggested that the fast streams associated with interaction regions may move the current sheet to higher heliographic latitudes when the source of the fast plasma is in the southern solar hemisphere.

9793 **Silicon lines as spectral diagnostics: the effect of charge transfer.** Baliunas, S.L.; Butler, S.E. (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA). *Astrophysical Journal, The (U.S.);* **235**: L45-L48(1 Jan 1980).

Attention is drawn to the importance of charge transfer as an ionization source in astrophysical plasmas. The effect of the rapid charge transfer reactions $Si^{+} + H^{+} \rightarrow Si^{+2} + H$ - 2.74 eV and $Si^{+2} + He^{+} \rightarrow Si^{+3} + He$ - 8.88 eV on the ionization equilibrium of silicon is calculated. The dominant ionization stage of silicon in a coronal plasma is shown to be Si^{+2} for temperatures as low as 20,000°K in contrast to the temperature of 35,000°K determined from earlier ionization equilibrium calculations. The Si^{+3} abundance is also substantially modified. For the quiet-Sun transition region, we calculate the effect of charge transfer upon the emissivity of the Si III λ 1892 emission line. The peak emissivity occurs at a temperature a factor of 2 lower and is an order of magnitude higher than implied by calculations neglecting the silicon charge-transfer process. The results have widespread importance for the interpretation of solar, stellar, interstellar, and extragalactic silicon lines.

6402 Atmospheric Physics

9794 **(AD-A—083010) Calculations pertaining to the energy balance and plasma motions in the ionosphere. Final report, 1 January-30 September 1978.** Dalgarno, A.; Constantinides, E. (Smithsonian Astrophysical Observatory, Cambridge, MA (USA)). Nov 1979. Contract F19628-78-C-0047. 142p. NTIS PC MF A01.

Plasma motions in the upper atmosphere have been investigated with the aid of satellite data. It is shown that the major ion, O^{+}, moves in response to the sum of the forces on itself and on electrons. Major ions follow the motion of the major ion. The observed plasma velocity in the vertical direction is in harmony with the assumption of an eastward electric field of between 3 and 5 millivolts per meter. The present investigation demonstrates clearly the need for measurements of electric fields and plasma drifts.

9795 **(AD-A—084756) Short term periodicities in ionospheric total electron content. Annual report No. 2, 1 October 1978-30 September 1979.** Schatten, K.H.; Mendillo, M. (Boston Univ., MA (USA). Dept. of Astronomy). Mar 1980. Contract F19628-77-C-0270. 54p. NTIS, PC A04/MF A01.

Short-term variability of the ionospheric F-region has been studied using total electron content (TEC) data from several North American sites. Specific attention was given to lunar-induced periodicities in TEC and to a general treatment of changes in TEC associated with variations in the height of the F-region (hmF2). In both cases, simple analytical expressions were derived from statistical analysis of the large TEC and hmF2 data bases. These relations are appropriate for updates to model predictions of average conditions during daytime hours. A study of the 'geomagnetic ordering' of TEC variability showed that real-time predictive methods can reduce up to 50% of the normal variability. A preliminary analysis of solar wind sector boundary effects suggested that sector components may order some F-region variability, though the specific relations between these effects and the geomagnetic ordering results remain to be clarified.

9796 **(AD-A—084915) Ultraviolet absorption cross sections of HO2NO2 vapor. Final report, September 1978-December 1979.** Molina, L.T.; Molina, M.J. (California Univ., Irvine (USA). Dept. of Chemistry). Apr 1980. Contract DOT-FA78WA-4248. 33p. NTIS, PC A03/MF A01.

The ultraviolet absorption cross sections for gas phase HO2NO2 have been measured between 190 and 330 nm, at 298K and 1 atm total pressure. The HO2NO2 vapor was prepared in a flowing N2 stream in the presence of H2O, H2O2, HNO3, and NO2. The composition of the mixture was established by visible and infrared absorption spectroscopy and by chemical titration after absorption in aqueous solutions. The experimental uncertainty (one standard deviation) ranges from 5% at 200 nm to 30% at 330 nm, and mainly falls in the 10% range. The solar photodissociation rate in the troposphere and lower stratosphere is estimated to be about ten to the -5th power/sec for 0 deg solar zenith angle.

9797 **(AD-A—084991) Roscoe manual, Volume 17-1 - high-altitude debris-energy deposition. Final report, 1 January 1976-30 June 1979.** Hamlin, D.A.; Myers, B.F.; Schoonover, M.R. (Science Applications, Inc., La Jolla, CA (USA)). 30 Jun 1979. Contract DNA001-76-C-0194. 100p. NTIS, PC A05/MF A01.

Models of the high-altitude debris-energy partition and deposition have been revised for use in ROSCOE-IR. The principal motivation has been to provide for the increase to 23 from 11 species carried in the high-altitude grid chemistry. However, wherever feasible, corrections, improvements, and updating of the models have been incorporated. Section 4 (UV Source Characteristics) and Section 9 (UV Deposition) of Volume 17 have been modified, and Section 7 (Partitioning of the Deposited Debris Energy and Consequent Species (Subroutine HPCHEM) and Section 10 (Prompt Chemistry Associated with Group-X and Group-U Energy Deposition (Subroutine PCHEM)) of Volume 17 have been completely revised. The remaining sections in Volume 17 are unchanged.

9798 **(DOE/ER/10161—1) Measurements of possible D- and E-region telecommunications effects during ionospheric heating. Final report.** Showen, R.L. (SRI International, Menlo Park, CA (USA)). Feb 1980. Contract AI01-80ER10160. 35p. NTIS, PC A03/MF A01.

For this research project, measurements were made of the effects that heating the ionosphere might have on the passage of radiowaves through the D- and E-regions. The purpose of this work was to simulate the effects of the proposed Solar Power Satellite microwave power beam on the lower ionosphere. The increased electron temperatures produced by the Platteville, Colorado, HF ionospheric heater caused cross-modulation on certain radiowaves when the heater was rapidly modulated (the Luxembourg effect). Small amounts of cross-modulation were detected at four frequencies between 60 kHz and 5 MHz. Attempts were made to detect phase path changes - indicative of electron number density changes - while the heater was slowly cycled on and off. No phase path changes could be seen for radiowaves of frequency 10.2 or 60 kHz. If these results are extrapolated to the powers and frequency of the Solar Power Satellite power beam, then no significant impact from D- and E-region modification on telecommunications services are expected.

9799 **(LA-UR—80-3674) Statistical properties of visible and infrared beams retroreflected through a turbulent atmosphere.** Slatkine, M.; Bensimon, D.; Englander, A.; Shtrikman, S.; Treves, D. (Los Alamos Scientific Lab., NM (USA); Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Electronics). 1980. Contract W-7405-ENG-36. 5p. (CONF-801201—3). NTIS, PC A02/MF A01.

From 3. international conference on lasers and applications; New Orleans, LA, USA (15 Dec 1980).

Statistical properties of HeNe and CO_2 laser beams retroreflected through a turbulent atmosphere are investigated experimentally for round paths of 1 km and 12 km. Both heterodyne and direct detection are used.

9800 **Multispacecraft observations of energetic electron flux pulsations at 6.6 R/sub E/.** Baker, D.N.; Higbie, P.R.; Belian, R.D. (Los Alamos Scientific Laboratory, University of California Los Alamos, New Mexico 87545). *Journal of Geophysical Research (U.S.);* **85**: No. A12, 6709-6718(1 Dec 1980).

This paper reports observations of highly periodic flux pulsations in >30-keV electrons measured by essentially identical Los Alamos National Scientific Laboratory charged particle anaylzers on board spacecraft 1976—059, 1977—077, and 1979—053 at geostantionary orbit. Oscillations with periods in the range from ~1 min to ~10 min (Pc 4 and Pc 5) have been studied. Statistical analyses were performed using ~4.5 years of data obtained at magnetic latitudes of 4.8 °, 9.4 °, and 11.4 °. The statistical occurrence probabilities have been evaluated for measurements made at each of the various magnetic latitudes and for all local times. Substantial magnetic latitude and seasonal dependence are found for the flux pulsation occurrence frequency versus local time. These results are discussed in terms of previous observations and present theories of magnetic pulsation generation.

9801 **Plasma flow in the magnetotail and its implications for substorm theories.** Hones, E.W. Jr. (Los Alamos Scientific Lab., NM). pp 545-562 of Dynamics of the magnetosphere. Akasofu, S.I. (ed.). Dordreicht, Holland; D. Reidel Publishing Company (1979).

The neutral line theory of substorms has evolved from early thinking about magnetic energy conversion in solar flares and in the outer magnetosphere and has now attained a relatively high level of sophistication. Some large-scale phenomena that are predicted by this theory are (a) plasma will flow rapidly earthward and tailward along the tail's midplane away from the merging region; (b) the component of the magnetic field normal to the midplane will be oppositely directed on the two sides of the merging region; (c) in large substorms magnetic merging can reach the field lines bounding the plasma sheet, possibly causing loss of the tailward portion of the plasma sheet to the solar wind. Observations with satellites located near the center of the tail at distances beyond 20 R/sub E/ have revealed combinations of these phenomena occurring in more than 25 substorms and ofen agreeing in remarkable detail with predictions of the theory. This paper deals primarily with plasma flow measurements during substorms and reports on a recent study that shows tailward flow to be much more prevalent than earthward flow during the expansive phase of substorms. This finding tends to contradict an earlier study that reported instances of earthward flow to far outnumber instances of tailward flow during (substorm-related) plasma sheet thinnings. It calls into question a rarefaction wave model of substorms that was partially based on that earlier report.

6403 Atomic, Molecular, And Chemical Physics

9802 **(AD-A—084984) Profile: a general code for fitting ion beam analysis spectra. Technical report.** Niiler, A.; Birkmire, R.; Gerrits, J. (Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab.). Apr 1980. 63p. NTIS, PC A04/MF A01.

A general program for analyzing energy distributions of particles scattered in ion beam experiments has been developed. This program uses numerical integration methods to model elastic scattering and nuclear reaction spectra from known cross sections, energy loss data and assumed depth concentration profiles of surface constituents. Direct comparison of the predicted and experimental distributions yields detailed, quantitative information about these depth concentration profiles in a complicated surface. The program is capable of analyzing all hydrogen or helium ion elastically scattered distributions and the (d,p) nuclear reaction peaks due to carbon, nitrogen, and oxygen. Analysis of the elemental concentration profiles of the surfaces of three different samples is discussed.

9803 **(COO—2875-15) Study of muonic atoms in the A = 40 to 70 and A = 100 to 130 mass regions (nuclear charge radii, isotope and isotone shifts) and in the Sm-Gd and W-Os-Pt transition regions (electric monopole and quadrupole moments). Progress report No. 5, December 1, 1979-October 15, 1980.** Steffen, R.M. (Purdue Univ., Lafayette, IN (USA). Dept. of Physics). Oct 1980. Contract AS02-76ER02875. 33p. NTIS, PC A03/MF A01.

The muonic x-ray spectra of the stable Ru and Pd isotope have been measured, and the data have been analyzed in terms of the effective Barrett radii and in terms of isotope shifts. The effects of the neutron subshell closure on the $\Delta N = 2$ isotopes shifts at $N = 56$ is much smaller in the Ru ($Z = 44$) isotopes as compared to the recently observed effect in the Mo ($Z = 42$) isotope shifts. This is the first time a pronounced difference in $\Delta N = 2$ isotope shifts has been observed for different values of Z. The muonic x-ray measurements on 24 stable isotopes of Cd, Sn, Te, and Ba have been completed and the analysis of the 74 spectra (including calibration spectra) is progressing. The work on the quadrupole parameters of the even-A Os nuclei has been completed. The analysis of the muonic x-ray spectra of the even-A Gd isotopes is near completion. Monopole and quadrupole charge parameters of the 0/sub $g/^+$ and 2/sub $g/^+$ states (and in the case of ^{160}Gd, of the 3^- state) have been determined. The model dependence of extracting point-quadrupole matrix elements from muonic x-ray measurements has been carefully investigated. It was found that neither the β-vibration nor the γ-vibration modes influence the value of the extracted point moments by more than 2 percent. The problem of nuclear polarization corrections was examined.

9804 **(DOE/ER/02887—2) Theoretical studies of highly ionized species. Progress report, March 1, 1980-February 28, 1981.** Dalgarno, A.; Victor, G.A. (Harvard Coll. Observatory, Cambridge, MA (USA)). Oct 1980. Contract AS02-76ER02887. 5p. NTIS, PC A02/MF A01.

The calculations of the charge transfer recombination and ionization rate coefficients for a wide range of ionic systems in collision with hydrogen and helium at thermal energies were completed. For the carbon ions in hydrogen, the calculations were extended to energies of 100 eV. The importance of the processes in ionized plasmas was demonstrated by studies of the solar corona and of shock waves. Preliminary results were obtained on cross sections for the excitation of fine structure transitions by proton impacts. The mechanisms leading to the photodissociation of alkali metal dimers were identified and quantitative predictions were made for Li_2. Calculations using the model potential method of properties of the Cu and Zn sequences were brought to a successful conclusion. Applications of the relativistic random phase approximation were made to the calculation of photoionization cross sections of magnesium-like and zinc-like ions and of oscillator strengths of mercury.

9805 **(LBL—11779) Collisions of highly stripped ions at MeV energies in gas targets: charge transfer and ionization.** Schlachter, A.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1980. Contract W-7405-ENG-48. 5p. (CONF-801111—37). NTIS, PC A02/MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

Cross sections have been measured for charge transfer and ionization in H_2 and rare-gas targets by fast, highly ionized carbon, iron, niobium, and lead ions in charge states +3 to +59, with energies in the range 0.1 to 4.8 MeV/amu. Experimental results are compared with classical-trajectory calculations; agreement is generally good. For a given target, the cross sections for net ionization reduce to a common curve when plotted as cross section divided by charge state versus energy per nucleon divided by charge state.

9806 **(ORNL/TM—7624) High voltage research (breakdown strengths of gaseous and liquid insulators) and environmental effects of dielectric gases. Semiannual report, April 1-September 30, 1980.** Christophorou, L.G.; James, D.R.; Pai, R.Y. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 136p. NTIS, PC A07/MF A01.

Electron attachment rate constants for five halogenated ethylene compounds have been measured in two background gases, and the corresponding attachment cross sections, σ/sub a/(ϵ), have been calculated. Electron attachment rates have also been measured for two perfluoroalkanes, and attachment cross sections have been calculated. A study of initial decomposition products of n-C_5F_{12} is also under way. The correlation of breakdown strength to fundamental knowledge continued. Breakdown strength shows strong dependence on the magnitude and energy dependence of the electron attachment cross section; it indicates that the increase in the breakdown voltage, V/sub s/, with increasing attachment saturates, suggesting an upper limit in V/sub s/ of $\sim$ 2.5 times that of SF_6. The problem of compressibility of some dielectric gases has been treated. A tabulation is presented of most dielectric strengths measured at Oak Ridge National Laboratory. One compound (CF_3OCH_3) was synthesized, and in breakdown tests it has demonstrated synergism with SF_6. Breakdown tests have been performed on several fluoro-chloro-hydrocarbon gases to study further the effect of attachment on dielectric strength. In impulse breakdown measurements, three moderators were compared for use in mixtures with two electron attaching gases. The effect of mixture components and proportions has been observed on corona stabilization of breakdown. The applied testing has concentrated on cylindrical geometry tests with smooth and rough electrodes to systematically determine optimum ternary mixtures of two attaching gases (SF_6 and c-C_4F_8) with one moderating gas (either N_2 or 1,1,1-$C_2H_3F_3$ or CHF_3).

9807 **(PNL-SA—8661) Ion implantation of krypton in sputter-deposited metal matrices.** Tingey, G.L.; McClanahan, E.D.; Nesbitt, J.F. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1980. Contract AC06-76RL01830. 19p. (CONF-8006150—1). NTIS, PC A02/MF A01.

From DOE meeting on ion implantation and zeloyte encapsulation technologies for immobilization of krypton-85; La Jolla, CA, USA (17 Jun 1980).

Krypton 85 has been successfully stored in a metal matrix by bombarding the metal surface with krypton ions while the metal is being deposited by sputtering. The krypton is thus incorporated into the metal in concentrations approaching 200 cm^3 of Kr(STP)cm^3 of deposit. Cost estimates of a facility to perform this work are given. (GHT)

9808 **H^- and D^- production by backscattering from alkali-metal targets.** Schneider, P.J.; Berkner, K.H.; Graham, W.G.; Pyle, R.V.; Stearns, J.W. (Lawrence Berkeley Laboratory, University of California , Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter (U.S.);* **23**: No. 3, 941-948(1 Feb 1981).

Measurements have been made of the total backscattered D^- and H^- yields from thick, clean targets of Cs, Rb, K, Na, and Li, bombarded with H^+_2, H^+_3, D^+_2, D^+_3 with incident energies from 0.15 to 4.0 keV/nucleus. All of the measurements were made at background pressures less than 10^{-9} Torr, and the alkali-metal targets were evaporated onto a cold substrate (T$\sim$77 K) in situ to assure thick, uncontaminated targets. For each target, the H^- and D^- yields exhibited maxima (as high as 0.08 per incident proton or deuteron) at incident energies between 0.3 and 1.4 keV/nucleus. For both hydrogen and deuterium incident at any energy, the negative-ion yield decreases in going form Cs to Li in the order given above. Also, a definite isotope effect was observed for every target used, with the H^- yield peaking at a lower incident energy than the D^- yield and in most cases, the maximum H^- yield was higher than the maximum D^- yield. Measurements of the D^- yield as a function

of Cs coverage were also made for D_3/sup ts+/ bombarding a Ni substrate. The D^- yield maximized at or near the coverage at which the surface work function reached a minimum.

9809 **Formation of H^- and D^- ions by hydrogen and deuterium particle backscattering from alkali-metal surfaces.** Hiskes, J.R.; Schneider, P.J. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review [Section] B: Condensed Matter (U.S.);* **23**: No. 3, 949-956(1 Feb 1981).

A model has been developed for the generation of negative ions by particles backscattered from alkali-metal surfaces. The negative-ion secondary-emission coefficient (NISEC) is taken to be the product of the backscattered particle energy and angular distribution, a negative-ion formation probability, and a survival probability. The backscattered distributions are calculated using the Marlowe Monte Carlo reflection code. The formation and survival probabilities have exponential forms with adjustable parameters α, β. A least-squares fit of the NISEC integral to the experimental data provides semiempirical values for the α, β. The survival probabilities are found to vary inversely with surface work function. The formation probabilities are dependent upon work function and valence electron density. The semiempirical survival probabilities are in fair agreement with earlier model calculations. The quality of the least-squares fits together with the survival probability comparisons represents a first point of contact for theory and experiment.

9810 **Terbium chloride—aluminum chloride vapor system. I. Absorption and excitation spectra.** Caird, J.A.; Carnall, W.T.; Hessler, J.P.; Williams, C.W. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 798-804(15 Jan 1981).

The absorption spectrum of the vapor complex formed at elevated temperatures between $TbCl_3$ and $AlCl_3$ has been measured in the region 20 000—50 000 cm^{-1}. Oscillator strengths of f—f absorption bands below 37 000 cm^{-1} were determined. Strong absorption due to opposite parity $4f^75d$ states was observed in the 37 000 to 50 000 cm^{-1} region with a peak molar absorptivity of approximately 500 l/mol cm. Significant additional absorption attributed to a molecular complex was also observed in this region. By measuring the excitation spectrum it was found that the molecular absorption does not appear to lead to fluorescence of the $^5D_4$ state. In contrast, absorption by the $4f^75d$ states does result in strong $^5D_4$ fluorescence.

9811 **Terbium chloride—aluminum chloride vapor system. II. Fluorescence.** Caird, J.A.; Hessler, J.P.; Carnall, W.T.; Williams, C.W. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 805-812(15 Jan 1981).

Measurements of the fluorescence spectra and fluorescence decay kinetics of the vapor complex formed at elevated temperatures between $TbCl_3$ and $AlCl_3$ have been made in the 350 to 700 nm wavelength range. The principal lines in the spectra were identified as emission from the $^5D_4$, $^5D_3$, and the $^5G_6$ energy levels of the Tb^{3+} ion. The radiative lifetime of the $^5D_4$ level at low temperatures was found to be 3.88 ms, and was used to determine the oscillator strenghts of the $^5D_4 \rightarrow {}^7F$/sub J/ (J=0 through 6) transitions after their branching ratios were measured. The peak cross section for stimulated emission on the strong $^5D_4 \rightarrow {}^7F_5$ transition was found to be 2.87 x 10^{-21} cm^2 at λ=543 nm. A population inversion of 10^{18} cm^{-3} could produce a small signal gain of 30% per meter on this transition, indicating that laser emission may be possible at temperatures where sufficient vapor density can be obtained.

9812 **Laser induced fluorescence spectrum of trapped BrCN cations.** Grieman, F.J.; Mahan, B.H.; O'Keefe, A. (Department of Chemistry and Materials and Molecular Research Division, University of California, Berkeley, California 94720). *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 857-861(15 Jan 1981).

Laser induced fluorescence spectra of mass selected $BrCN^+$ confined in a three dimensional quadrupole trap are presented. Using this technique, the B ^{2}Pi—X ^{2}Pi system of $BrCN^+$ is investigated. Approximate values for the C—Br stretching frequencies (ν'_1=441 +- 18 cm^{-1}, ν_1''=509 +- 16 cm^{-1}) and the difference of the spin—orbit splitting constants ($A''-A'$=224 +- 43 cm^{-1}) are determined. However, the spectrum is complicated by irregular vibrational and spin—orbit splitting spacing, yielding a large uncertainty in these values. The existence of sequence bands and a Fermi resonance interaction provides possible explanations for these irregularities.

9813 **Helical polymer circular dichroism: Transition matrix theory for polypeptides.** Rabenold, D.A. (Institute of Molecular Biophysics, The Florida State University, Tallahassee, Florida 32306). *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 941-947(15 Jan 1981).

A Green operator technique used within a linear response framework is employed to present a transition matrix theory of long helical polymer circular dichroism. Specializing to a polypeptide, simple closed form expressions are obtained for the circular dichroism. The formulation clearly shows (1) how the PiPi* exciton system gives rise to the "helix band" and "radial bands"; (2) how the coupling of the PiPi* and nPi* transition densities gives rise to a band centered at the unperturbed nPi* transition frequency which is balanced in rotational strength by bands at the PiPi* perpendicular and parallel polarized transition frequencies; and (3) how interaction of these low energy transitions with high energy transitions can alter all of the above mentioned bands.

9814 **Cluster dynamics: A classical trajectory study of A(/sub n/→A/sub n/-1+A.** Brady, J.W.; Doll, J.D.; Thompson, D.L. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 1026-1028(15 Jan 1981).

The dynamics of the dissociation of quasibound clusters of atoms have been studied using classical trajectories with a Metropolis-type sampling procedure for averaging over the dynamical variables for fixed initial energy values. The case $A_4 \rightarrow A_3 + A$ was examined for mass and potential parameters appropriate for Ar. Calculations were carried out for pairwise Lennard-Jones potentials. The computed decay rates are in good agreement with those reported previously [J. Chem. Phys. 71, 2467 (1979)] where the quasibound clusters were collisionally formed from A and internally cold A_3.

9815 **Electronic structure and dissociation curves for the ground states of Tl_2 and Tl_2^+ from relativistic effective potential calculations.** Christiansen, P.A.; Pitzer, K.S. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 1162-1165(15 Jan 1981).

The dissociation curves for the ground states of Tl_2 and Tl_2^+ were computed using a generalization of the molecular relativistic ω—ω coupling formalism of Lee, Ermler, and Pitzer. Relativistic effects, as represented by the Dirac equation, were introduced using effective potentials generated from atomic Dirac—nFock wave functions using a generalization of the improved effective potential formulation of Christiansen, Lee, and Pitzer. Our calculations show that the ground state of Tl_2^+ is 1/2/sub g/ with computed D/sub e/ and R/sub e/ values of 0.58 eV and 3.84 A. For Tl_2 we find that the ground state is 0/sub u/$^-$ but the 0/sub g/$^+$ and the 1/sub u/ states are only slightly higher in energy; the potential curves for these states are repulsive to about 3.5 A and then essentially flat beyond that radius. While corrections for correlation will increase D/sub e/ somewhat, Tl_2 is only weakly bound in any of these states which dissociate to normal atoms. The cause is undoubtedly related to the large spin-orbit splitting between the 6p/sub 1/2/ and 6p/sub 3/2/ thallium spinors.

9816 **Satellite structure in the 5p and 5s x-ray-photoelectron spectra of the actinides.** Boring, M.; Cowan, R.D.; Martin, R.L. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter (U.S.);* **23**: No. 2, 445-448(15 Jan 1981).

In this article, we report the results of a configuration-interaction study of the 5s and 5p hole (denoted by 5s, 5p) states in Ra,

Th, and U atoms. Our most important finding is that all of the major satellite features in the 5p spectra of these solids can be accounted for by an atomic model without recourse to "shakeup" losses arising from extra-atomic relaxation in the solid. Our results for the 5s region of the actinides show a strong 5s→5p5d5f interaction and suggest that this level should also be significantly perturbed by the continuum channels 5p5def.

9817 Electron capture by Ne^{10+} trapped at very low energies. Vane, C.R.; Prior, M.H.; Marrus, R. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). W-7405-ENG-48. *Physical Review Letters (U.S.);* **46**: No. 2, 107-110(12 Jan 1981).

An electrostatic ion trap was used to trap Ne/sup q/+(1< or =q< or =10) ions created by a fast xenon beam passing through neon gas. Exponential decay in time of the Ne^{10+} fraction due to electron capture from neon gas was observed and the decay rates measured. For mean kinetic energies between 7—45 eV, the total electron-capture cross section (σ/sub e/c) is found to be velocity independent. For this energy range we obtain σ/sub e/c(Ne^{10+})=2.4 x 10^{-15} cm^2, with an estimated uncertainty of 30%.

9818 Laser resolution of unpolarized-electron scattering cross sections into spin-conserved and spin-flip components. Ritchie, B. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review Letters (U.S.);* **46**: No. 1, 18-21(5 Jan 1981).

The theory is presented for one-photon free-free absorption by electrons scattering from high-Z atoms. The absorption cross section provides sufficient information to resolve the unpolarized-electron total cross section, $f(\theta)^2 + g(\theta)^2$, into its individual components for spin-nonflip, $f(\theta)^2$, and spin-flip, $g(\theta)^2$, scattering. The observation of a spin-polarization effect for a spin-independent process (free-free absorption) is analogous to the Fano effect for bound-free absorption.

9819 Triply-differential photoelectron studies of molecular autoionization profiles: The 710—730-A region of the N_2 spectrum. Parr, A.C.; Ederer, D.L.; Cole, B.E.; West, J.B.; Stockbauer, R.; Codling, K.; Dehmer, J.L. (Synchrotron Ultraviolet Radiation Facility, National Bureau of Standards, Washington, D.C. 20234). *Physical Review Letters (U.S.);* **46**: No. 1, 22-25(5 Jan 1981).

Photoelectron studies of molecular autoionization resolved into position within the resonance profile, photoelectron ejection angle, and final vibrational state are reported. By using the first members of prominent window and absorption series converging to N_2/sup ts+/ $B^2\Sigma$/sub u/$^+$ as an example, striking variations of vibrational branching ratios and photoelectron asymmetry parameters within autoionizing profiles are demonstrated. Such triply differential data represent a very detailed characterization of the rovibronic interactions governing molecular autoionization.

9820 Electromagnetic instabilities in a focused ion beam propagating through a z-discharge plasma. Ottinger, P.F.; Mosher, D.; Goldstein, S.A. (Naval Research Laboratory, Washington, D.C. 20375). *Physics of Fluids, The (U.S.);* **24**: No. 1, 164-170(Jan 1981).

A beam-plasma system consisting of a focused light ion beam propagating through a z-discharge plasma is analyzed for electromagnetic velocity space instabilities. In particular, the Weibel (kxB$_0$=0, kxV/sub z/≅0) and the whistler (k x B$_0$≅0, kxV/sub z/=0) instabilities are studied. It is found that unstable modes do not grow fast enough to affect the beam propagation in a pellet-fusion-reactor chamber. For kxV/sub z/> or ≈0, the instabilities convect with a velocity much less than the beam streaming velocity.

9821 Alkalilike spectra in the promethium isoelectronic sequence. Curtis, L.J.; Ellis, D.G. (Department of Physics and Astronomy, University of Toledo, Toledo, Ohio 43606). DE-AS-05-80ER10676. *Physical Review Letters (U.S.);* **45**: No. 26, 2099-2102(29 Dec 1980).

Highly ionized members of the Pm sequence should produce strong resonance lines in the uv spectra of hot plasmas contaminated by heavy elements. These ions for Z> or =74 have an alkali structure with ground configuration $4f^{14}5s$. Hartree-Fock calculations show that in W XIV through U XXXII the dominant resonance lines are the 5s-5p doublets in the range λ=100—400 A. Approximate predictions are given for the doublet wavelengths, line strengths, and mean lives.

9822 Study of the accuracy of the pseudo-potential formalism. Das, G. (Argonne National Lab., IL). *Chemical Physics Letters (Netherlands);* **71**: No. 2, 202-206(15 Apr 1980).

A critical evaluation of the applicability of the pseudo-potential methods to the study of the interaction potential in molecular systems is presented. Actual comparison is made between the all-electron frozen core results on the ground and excited states of Cs_2^{2+} and the corresponding pseudo-potential results.

9823 Differential cross sections for e-LiF scattering. Siegel, J. (Argonne National Lab., IL (USA)); Dehmer, J.L.; Dill, D. *Journal of Physics, B (London). Atomic and Molecular Physics (Formerly Journal of Physics, B (London). Proceedings of the Physical Society (Atomic and Molecular Physics)) (England);* **13**: No. 6, L215-L219(28 Mar 1980).

Differential cross sections are calculated for e-LiF scattering from 1 to 20 eV using a three-part hybrid method in which low-l partial waves are calculated using the multiple-scattering method, intermediate-l partial waves are calculated using the closed-form point dipole method and high-l waves are obtained using the first Born approximation. Good agreement between theory and experiment at 5.44 and 20 eV confirms the suitability of both the three-part hybrid approach and of the three separate approximations used therein. The differential cross section spectrum is dominated by dipole scattering at small angles, but clearly shows the influence of the molecular core at intermediate and large angles. No evidence of resonant activity is seen in this energy range.

9824 Optical observations of molecular dissociation in thin foils. Gay, T.J.; Berry, H.G. (Argonne National Lab., IL). *Journal of Physics, B (London). Atomic and Molecular Physics (Formerly Journal of Physics, B (London). Proceedings of the Physical Society (Atomic and Molecular Physics)) (England);* **13**: L199-L204(1980).

Measurements were made of the intensity and polarization of light emitted from two excited states of neutral helium, after breakup of the HeH^+ molecule in thin foils. The foil thickness was varied to study the dependence on the internuclear separation of the He and proton at the final foil surface and postulate that the variations observed are sensitive to the molecular orbitals of the dissociating HeH^+ molecule. These vicinage effects provide the distance scale of the final state interaction at the foil surface.

9825 Diabatic and resonance molecular states. Dalgarno, A. (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA). *Physica Scripta (Sweden);* **21**: 492-494(1980).

The concept of diabatic and resonance molecular states is discussed. A recent definition of diabatic states is presented. Current investigations of resonace states of molecular hydrogen are summarized and detailed calculations of the dissociative photoionization of H_2 are reported.

9826 Applications of the relativistic random phase approximation. Shorer, P.; Dalgarno, A. (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA). *Physica Scripta (Sweden);* **21**: 432-435(1980).

Some recent calculations using the relativistic random phase approximation are briefly described. The ^1P and ^3P energy levels of several highly stripped helium-like ions are tabulated and photoionization cross sections of neutral magnesium and zinc and of magnesium-like and zinc-like molybdenum ions are presented.

6404 Fluid Physics

9827 (SAND—80-2566) COUPLEFLO: a computer program for coupled creeping viscous flow and conductive-convective heat transfer addendum. Chavez, P.F.; Dawson, P.R. (Sandia National Labs., Albuquerque, NM (USA); Cornell Univ., Ithaca, NY (USA). Sibley School of Mechanical and Aerospace Engineering). Nov 1980. Contract AC04-76DP00789. 45p. NTIS, PC A03/MF A01.

COUPLEFLO is a two-dimensional finite element code for plane strain or axisymmetric analyses of thermomechanically coupled systems. It is capable of analyzing the creeping flow of non-Newtonian fluids or the primary and secondary creep of solids. COUPLEFLO solves equations for conductive-convective heat transfer to determine the thermal response of a system. Thermomechanical coupling between the flow field and temperature distribution can exist in terms of temperature dependent material properties, temperature dependent body forces, viscous dissipation, material convection, and changing system geometry. Either transient or steady-state problems can be analyzed in Eulerian or quasi-Lagrangian reference frames. This document describes improvements to the computer code that have been made since previous reports detailing the theoretical background and code use were published.

9828 (UCRL—84559) Interaction of moderately dense particle concentrations in turbulent flow. Buckingham, A.C.; Siekhaus, W.J. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 1981. Contract W-7405-ENG-48. 16p. (CONF-810106—3). NTIS, PC A02/MF A01.

From 19. Aerospace Sciences meeting; St Louis, MO, USA (12 Jan 1981).

Numerical simulations are presented which describe fluctuating gas motions and effects of resulting forces on gas-borne particulates. The effects include the back influence of the particulates on the turbulent gas field that convects them. Force, energy and motion coupling between particles and gas is moderately influential consistent with the modest levels of particle-to-gas mass loading (the order of 0.01 to 0.1), associated with use of erosion suppressing particulate additives. Back influence consists of inertial and volumetric effects as well as modeled acoustical coupling, where appropriate. Preliminary results of complementary wind tunnel experiments, measuring influences of particle loading on turbulent structures, are also presented.

9829 Gradient theory of fluid microstructures. Davis, H.T.; Scriven, L.E. (Departments of Chemical Engineering and Materials Sciences and of Chemistry, University of Minnesota, Minneapolis, Minnesota). *Journal of Statistical Physics (U.S. - England);* **24**: No. 1, 243-268(Jan 1981).

The general gradient theory of fluid microstructures is outlined. This theory reduces the determination of fluid microstructures to a boundary value problem. The density and pressure tensor profiles and the tension of planar thin films and layered structures in one-component fluids are investigated. The boundary conditions determining these structures are given a geometric interpretation in the free energy-density diagram. Discussed are the implications of the theory for the validity of Antonov's rule, the duplex film hypothesis, and the asymptotic theory of disjoining pressure and of the origin of a characteristic length scale in spinodal decomposition.

9830 Jet formation experiments and computations with a Lagrange code. van Thiel, M.; Levatin, J. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). W-7405-ENG-48. *Journal of Applied Physics (U.S.);* **51**: No. 12, 6107-6114(Dec 1980).

A jet formation routine has been generated that can be used with (Lagrange) explosive cone-collapse calculations. It calculates the velocities of jet and slug elements, as well as their mass, formation point, and time. The equations and method of operation are presented here. Experimental jet velocities agree with the model to 10%. Jet deformation calculations required yield strengths up to 24 kbar to yield agreement with experiments on copper jets.

9831 Spline collocation solution of combined radiation-convection in thermally developing flows with scattering. Chawla, T.C.; Chan, S.H. pp 47-65 of Numerical heat transfer. Volume 3. Washington, DC; Hemisphere Publishing Corporation (1980).

A collocation method employing piecewise cubic splines as approximating functions and Gaussian quadrature points as the colloction points provides a very convenient technique for the solution of thermally developing combined radiation-convection problems with and without radiation scattering. It is demonstrated that this method provides an alternative noniterative technique that with a small number of equations can produce a more accurate solution than the existing iterative methods. For the solution of these problems by the colloction method, one needs only the standard software available at any computing laboratory, thus considerably reducing the preparation time for successfully setting up the problem on the computer. It is shown that the existing solution for the case of thermally developng slug flow with radiation scattering suffers from inaccuracies.

9832 Intermittency in free turbulent shear flows. Dopazo, C. (Brookhaven National Lab., Upton, NY); O'Brien, E.E. pp 6-23 of Turbulent shear flows. I. Durst, F.; Launder, B.E.; Schmidt, F.W.; Whitelaw, J.H. (eds.). New York, NY; Springer-Verlag (1979).

A formalism previously used in the context of deformable porous media and turbulent/nonturbulent intermittent flows is restated here. The behavior of the intermittency function derivatives at the interface gives rise to surface integrals over the latter. The conditioned equations of continuity, momentum, energy, vorticity, and conservation of a scalar are derived for the turbulent and irrotational zones. Surface integrals with a precise physical meaning enter the conditioned equations. They can be interpreted as entrainment of mass, momentum, energy and scalar, and as direct interactions between the turbulent and irrotational regions. Use is made of the experimental conditioned measurements for: (1) the plane wake behind a heated flat plate, and (2) the heated turbulent round jet; the profiles of entrainment of mass and the combination of direct interactive force and entrainment of momentum are calculated. These derived profiles are compared with models proposed by previous investigators.

9833 Friction parameter of an ion near a metal surface. Ferrell, T.L.; Echenique, P.M.; Ritchie, R.H. (Oak Ridge National Lab., TN). *Solid State Communications (England-U.S.);* **32**: 419-422(1979).

The force on an ion located near a condensed-matter surface determines its Brownian motion along the surface. The dissipative component of this force was studied using a model in which the ion interacts with a metal while moving parallel with its surface. The known asymptotic form of the force is recovered for large separations when only electron-hole excitations are accounted for but a different form is found when damping of collective states is included.

6451 Particle Interactions And Properties - Experimental

9834 (CEA-CONF—4999) Structure functions extracted from muon pair production at the SPS. Burgun, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). 1979. 17p. (CONF-790774—4). NTIS (US Sales Only), PC A02/MF A01.

From SLAC summer institute on particle physics: quantum chromodynamics; Stanford, CA, USA (9 Jul 1979).

Dimuon data provided by πN interactions were analyzed in the framework of the Drell-Yan quark fusion model in order to extract the pion and nucleon structure functions. Our results are compared to the structure functions obtained in other experiments.

9835 (COO—4831-3) Weak decays and charm searches. Annual progress report, March 1, 1980-February 28, 1981. Nicholson, H.W. (Mount Holyoke Coll., South Hadley, MA (USA)). Oct 1980. Contract AS02-78ER04831. 9p. NTIS, PC A02/MF A01.

Results of statistically precise measurements of K^- p and anti pp scattering cross sections, discussed in Annual Progress Report COO-4831-2, dated October 1979, were published in Physical Review and Physical Review Letters. Progress has been made in

solving technical problems in a Brookhaven experiment in collaboration with experimenters from Yale and Brookhaven to measure the asymmetry parameter in the radiative decay $\Sigma^+ \rightarrow p\gamma$. An experiment has been designed in collaboration with experimenters from the Lawrence Berkeley Laboratory and Brookhaven to search for the charmed eta and eta' mesons.

9836 Direct electron production in low energy anti-pp annihilations. Levman, G.; Singer, R.; Fields, T. (Argonne National Lab., IL (USA)). pp 309-318 of Proceedings of the 4. European antiproton conference. Barr, 25-30 Jun 1978. Fridman, A. (comp.). Paris, France; Centre National de la Recherche Scientifique (1979).

From 4. European antiproton symposium; Barr, France (25 Jun 1978).

In an exposure of the ANL 12-foot hydrogen bubble chamber to a stopping anti-p beam, the production of electron pairs is studied. The preliminary data, based on 79.3K annihilations, contain five events with an e^+e^- pair whose mass is greater than that of the π^0. Possible sources of these events are the radiative decays $eta^0 \rightarrow \gamma e^+e^-$, and $\omega^0 \rightarrow \pi^0 e^+e^-$. To evaluate these sources, the rate of inclusive eta^0 and ω^0 production is measured by analyzing events with two or more γ rays converting the chamber liquid. It is found $eta^0/\pi^0 < 0.11$ (90% confidence) and $\omega^0/\pi^0 = 0.17 +- 0.04$. It then follows that eta^0 and ω^0 decay are unlikely to account for all of the high mass events.

9837 Search for exotic mesons produced in anti-pN interactions. pp 467-482 of Proceedings of the 4. European antiproton conference. Barr, 25-30 Jun 1978. Fridman, A. (comp.). Paris, France; Centre National de la Recherche Scientifique (1979).

From 4. European antiproton symposium; Barr, France (25 Jun 1978).

A high statistics hybrid bubble chamber experiment has been started triggering on a fast forward π^{+-}, K^{+-} or proton produced in anti-pp and anti-pd interactions at 6.1 and 8.9 GeV/c. In the first run 325,000 pictures of anti-pp interactions have been obtained corresponding to approximately 10 evts/μb at 8.9 GeV/c, and to approximately 30 evts/μb at 6.1 GeV/c. Details on the performance of SLAC Hybrid Facility in this experiment are presented as well as some preliminary results on inclusive topological cross-sections in reaction anti-pp$\rightarrow\pi^+X^-$, based on scanning of approximately 10% of the present sample.

9838 Baryon resonance production via positive virtual baryon exchange in πpp at 8 GeV/c. Eisenstein, B.; Elliot, J.; Nelson, B.; Wagner, R.G.; Wroblicka, W.T. (Illinois Univ., Urbana (USA)); Watson, J. (Argonne National Lab., IL (USA)); Gelfand, N.M.; Morris, G.R. (Chicago Univ., IL (USA)). pp 565-579 of Proceedings of the 4. European antiproton conference. Barr, 25-30 Jun 1978. Fridman, A. (comp.). Paris, France; Centre National de la Recherche Scientifique (1979).

From 4. European antiproton symposium; Barr, France (25 Jun 1978).

Preliminary results are presented on the backward reaction $\pi^- p \rightarrow n\pi^+\pi^+\pi^-\pi^-$ at 8 GeV/c. The experiment was performed in the University of Illinois - Argonne National Laboratory streamer chamber at the ZGS. Events were selected by the detection of the fast neutron in a set of thick-plate spark chambers and scintillation counters 11 m. downstream of the target. 1015 events, the result of 3C fits, have been selected and studied for the final state channels $(N^{*0}, \Delta^0) + (rho^0, f^0)$, which occur via the exchange of a positive baryon. Preliminary results on mass spectra, u-distributions, and cross-sections are presented.

9839 Nucleon structure functions from measurements of inelastic neutrinoand antineutrino interactions. Heagy, S.M.; Benvenuti, A.; Cline, D.; Reeder, D.D.; Trinko, T.; Winn, D.R.; Bobisut, F.; Cooper, p.S.; Gilchriese, D.G.D.; Mann, A.K.; Johnson, M.E.; Lundy, R.; Mori, R.; Stefanski, R.; McIntyre, P.; Rich, J.A.; Ling, T.Y.; Imlay, R. (double-daggerepartment of Physics, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review, The, D. Particles and Fields (U. S.);* **23**: No. 5, 1045-1069(1 Mar 1981).

This paper presents the final results on charged-current neutrino and antineutrino interactions with nuclei from experiment E-310 at Fermi National Accelerator Laboratory. The data sample, consisting of 21 578 neutrino-induced and 7358 antineutrino-induced events within the fiducial region in the energy range $20<E<325$ GeV, is exhibited first to demonstrate the basic properties and kinematic regions represented. The dependence of the nucleon structure functions on the dimensionless variable x and on neutrino energy is then described. Lastly, the variations of the structure functions with x and Q^2 are presented. The emphasis throughout has been to understand the effects on the final results of uncertainties in the systematic corrections required by the data. Comparisons with the results of other neutrino experiments are made.

9840 Evidence for new-flavor production at the Y(4S). Bebek, C.; Haggerty, J.; Izen, J.M.; Longuemare, C.; Loomis, W.A.; Pipkin, F.M.; Rohlf, J.; Tanenbaum, W.; Wilson, R.; Sadoff, A.J.; Bridges, D.L.; Chadwick, K.; Ganci, P.; Kagan, H.; Kass, R.; Lobkowicz, F.; Melissinos, A.; Olsen, S.L.; Poling, R.; Rosenfeld, C.; Rucinski, G.; Thorndike, E.H.; Warren, G.; Bechis, D.; Mueller, J.J.; Potter, D.; Sannes, F.; Skubic, P.; Stone, R.; Brody, A.; Chen, A.; Goldberg, M.; Horwitz, N.; Kandaswamy, J.; Kooy, H.; Lariccia, P.; Moneti, G.C.; Alam, M.S.; Csorna, S.E.; Panvini, R.S.; Poucher, J.S.; Andrews, D.; Berkelman, K.; Cabenda, R.; Cassel, D.G.; DeWire, J.W.; Ehrlich, R.; Ferguson, T.; Gentile, T.; Gilchriese, M.G.D.; Gittelman, B.; Hartill, D.L.; Herrup, D.; Herzlinger, M.; Kreinick, D.L.; Mistry, N.B.; Nordberg, E.; Perchonok, R.; Plunkett, R.; Shinsky, K.A.; Siemann, R.H.; Silverman, A.; Stein, P.C.; Stone, S.; Talman, R.; Thonemann, H.G.; Weber, D. (Harvard University, Cambridge, Massachusetts 02138). *Physical Review Letters (U.S.);* **46**: No. 2, 84-87(12 Jan 1981).

An enhancement has been observed in the inclusive cross section for direct single electrons produced in e^+e^- annihilation at the Y(4S). This is interpreted as evidence for a new weakly decaying particle, the B meson. A branching ratio for $B\rightarrow Xe\nu$ of [13 +- 3(+- 3)]% is inferred, where the first set of errors is statistical and the estimated systematic error is enclosed in parentheses.

9841 Decay of b-flavored hadrons to single-muon and dimuon final states. Chadwick, K.; Ganci, P.; Kagan, H.; Kass, R.; Lobkowicz, F.; Melissinos, A.A.; Olsen, S.L.; Poling, R.; Rosenfeld, C.; Rucinski, G.; Thorndike, E.H.; Mueller, J.J.; Potter, D.; Sannes, F.; Skubic, P.; Stone, R.; Brody, A.; Chen, A.; Goldberg, M.; Horwitz, N.; Kandaswamy, J.; Kooy, H.; Lariccia, P.; Moneti, G.C.; Alam, M.S.; Csorna, S.E.; Panvini, R.S.; Poucher, J.S.; Andrews, D.; Berkelman, K.; Cabenda, R.; Cassel, D.G.; DeWire, J.W.; Ehrlich, R.; Ferguson, T.; Gentile, T.; Gilchriese, M.G.D.; Gittelman, B.; Hartill, D.L.; Herrup, D.; Herzlinger, M.; Kreinick, D.L.; Mistry, N.B.; Nordberg, E.; Perchonok, R.; Plunkett, R.; Shinsky, K.A.; Siemann, R.H.; Silverman, A.; Stein, P.C.; Stone, S.; Talman, R.; Thonemann, H.G.; Weber, D.; Bebek, C.; Haggerty, J.; Izen, J.M.; Longuemare, C.; Loomis, W.A.; Mackay, W.W.; Pipkin, F.M.; Rohlf, J.; Tanenbaum, W.; Wilson, R.; Sadoff, A.J.; Bridges, D.L. (University of Rochester, Rochester, New York 14627). *Physical Review Letters (U.S.);* **46**: No. 2, 88-91(12 Jan 1981).

An enhancement in the inclusive cross section for single muons produced in e^+e^- annihilations at the Y(4S) is observed, confirming the interpretation that a new bare flavor (B mesons) is produced at the Y(4S). A branching ratio for $B\rightarrow X\mu\nu$ of (9.4 +- 3.6)% is obtained. The two-muon decay, $B\rightarrow X\mu^+\mu^-$, is not observed, providing a 90%-confidence-level upper limit for the branching ratio for the decay of 1.7%. Combining this with our previously reported limit of 5% for $B\rightarrow Xe^+e^-$, we obtain 1.3% as an upper limit for $B\rightarrow Xl^{+-}$.

9842 Total width and leptonic branching ratio of the Y(9.46). Niczyporuk, B.; Zeludziewicz, T.; Chen, K.W.; Hartung, R.; Vogel, H.; Wegener, H.; Bienlein, J.K.; Graumann, R.; Krueger, J.; Leissner, M.; Rippich, C.; Schmitz, M.; Filos, E.; Heimlich, F.H.; Nernst, R.; Schwarz, A.; Strohbusch, U.; Zschorsch, P.; Engler, A.; Kraemer, R.W.; Messing, F.; Ridge, T.; Stacey, B.J.; Youssef, S.; Fridman, A.; Alexander, G.; Av-Shalom, A.; Bella, G.; Gnat, Y.; Grunhaus, J.; Hoerber, E.; Langguth, W.; Scheer, M. (Institute of Nuclear Physics, Cracow, Poland). *Physical Review Letters (U.S.);* **46**: No. 2, 92-95(12 Jan 1981).

Using the LENA detector at the DORIS e^+e^- storage ring, we have measured the hadronic cross section and the μ-pair decay branching ratio of the Y(9.46) resonance. We obtain Γ/sub e/e=1.23 +- 0.10(+- 0.14) keV, B/sub mumu/=3.5 +- 1.4(+- 0.4)%, and Γ/sub tot/=35^{+25}/sub -/10($^{+9}$/sub -/7) keV; the first error number gives the statistical uncertainty. The numbers in parentheses represent systematic errors arising from the uncertainty in the total hadronic cross section.

9843 Polarization of muoproduced J/psi(3100). Clark, A.R.; Johnson, K.J.; Kerth, L.T.; Loken, S.C.; Markiewicz, T.W.; Meyers, P.D.; Smith, W.H.; Strovink, M.; Wenzel, W.A.; Johnson, R.P.; Moore, C.; Mugge, M.; Shafer, R.E.; Gollin, G.D.; Shoemaker, F.C.; Surko, P. (Physics Department and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). W-7405-ENG-48;DE-AC02-76ER03072;EY-76-C-02-3000. *Physical Review Letters (U.S.);* **45**: No. 26, 2092-2095(29 Dec 1980).

The polarization and Q^2 dependence of muoproduced psi→$\mu^+\mu^-$ have been analyzed in a magnetized-steel calorimeter at Fermilab. The reaction γ/sub V/N→psiN is found to be helicity conserving. Even after allowance for possible Q^2 dependence of the decay angular distribution, the psi muoproduction cross section falls more steeply in Q^2 than predicted by psi dominance.

9844 Comparison of νn and νp charged-current cross sections from high-energy neutrino interactions in deuterium. Hanlon, J.; Burnstein, R.A.; Rubin, H.A.; Chang, C.Y.; Dombeck, T.; Snow, G.A.; Son, D.; Steinberg, P.H.; Engelmann, R.; Kafka, T.; Sommars, S.; Kitagaki, T.; Tanaka, S.; Yuta, H.; Abe, K.; Hasegawa, K.; Yamaguchi, A.; Tamai, K.; Hayashino, T.; Kunori, S.; Ohtani, Y.; Hayano, H.; Chang, C.C.; Mann, W.A.; Schneps, J. (Illinois Institute of Technology, Chicago, Illinois 60616). *Physical Review Letters (U.S.);* **45**: No. 23, 1817-1821(8 Dec 1980).

From an analysis of the reaction ν/sub μ/+d→μ^- +X, obtained from an exposure of the Fermilab 15-ft deuterium-filled bubble chamber, the ratios charged-current cross sections for E/sub ν/>10 GeV are determined to be $\sigma(\nu n)/\sigma(\sigma p)$=2.03 +- 0.28 for <E/sub ν/>=50 GeV, and σ(nu-barn)/σ(nu-barp)=0.51 +- 0.16 for <E/sub nu$/=40 GeV. Bjorken-$\gamma$x distributions for neutron and proton targets shown that the majority quark in the nucleon has a broader momentum distribution in the infinite momentum frame than does the minority quark.

9845 Parity nonconservation in proton-nucleus scattering at 6 GeV/c. Lockyer, N.; Romanowski, T.A.; Bowman, J.D.; Hoffman, C.M.; Mischke, R.E.; Nagle, D.E.; Potter, J.M.; Talaga, R.L.; Swallow, E.C.; Alde, D.M.; Moffett, D.R.; Zyskind, J. (Department of Physics, Ohio State University, Columbus, Ohio 43210). *Physical Review Letters (U.S.);* **45**: No. 23, 1821-1824(8 Dec 1980).

A parity-nonconservation asymmetry has been measured in the total cross section for 6-GeV/c polarized protons on a water target. The asymmetry A/sub L/=(sigma/sub +/-σ/sub -/)/(σ/sub +/+σ/sub -/), defined as the fractional difference of total cross sections for positive- and negative-helicity protons on an unpolarized target, is A/sub L/2.65=(plus-or-minus0.60) x 10^{-6}. The quoted error includes both statistical and systematic contributions.

9846 High energy e^+e^- interactions. Panvini, R.S.; Csorna, S.E. (eds.). Schenectady, NY; American Institute of Physics (1980). 415p. (CONF-800588—).

From International symposium on high energy e+e- interactions; Nashville, TN, USA (1 May 1980).

Four of the nineteen papers in these proceedings have already been processed for inclusion in the TIC data base, and can be located by reference to the CONF- number. The remaining fifteen will be announced when they are received from AIP. (RWR)

9847 Study of baryon-antibaryon systems in the reaction πip→π^+p anti-pp at 11.5 GeV/c. Key, A.W.; Schwarzschild, B.M.; Wong, M. (Toronto Univ., Ontario (Canada)). pp 611-635 of Proceedings of the 4. European antiproton conference. Barr, 25-30 Jun 1978. Fridman, A. (comp.). Paris, France; Centre National de la Recherche Scientifique (1979).

From 4. European antiproton symposium; Barr, France (25 Jun 1978).

Data are given on the reaction π^+p→p anti-ppπ^+ (1) at 11.5 GeV/c, from a 250 events/μb exposure of the SLAC 40" hybrid-bubble-chamber facility, triggered on a fast p, anti-p K^+, or K^-. The hybrid-bubble-chamber system is described and a brief overview of reaction (1) is given noting that π exchange appears to be of little importance. Preliminary evidence for a narrow anti-pp enhancement at 1954+-5 MeV, produced in the forward direction is reported. The production cross section for this enhancement is about 300 nb, and the observed Gaussian width (sigma=10 MeV) is consistent with the mass resolution.

9848 Annihilation and selected features of nonannihilation in anti-pp interactions at 8.9 GeV/c. Lewis, R.A.; Miller, R.J.; Oh, B.Y. (Michigan State Univ., East Lansing (USA). Dept. of Physics). pp 207-236 of Proceedings of the 4. European antiproton conference. Barr, 25-30 Jun 1978. Fridman, A. (comp.). Paris, France; Centre National de la Recherche Scientifique (1979).

From 4. European antiproton symposium; Barr, France (25 Jun 1978).

Experiments to study anti-pp interactions in the intermediate and high energy regimes performed using the 30-inch bubble chamber hybrid facility at Fermilab are presented. The intermediate energy work has just been completed; this taking approximately 1.1 x 10^6 pictures. Preliminary results involved are described here.

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REFER ALSO TO CITATION(S) 9842, 9846, 9870, 9893

9849 Symmetry breaking and the decays psi' → J/psi π^0(eta) and J/psi → eta(eta') γ. Langacker, P. (Stanford Linear Accelerator Center, CA (USA); Pennsylvania Univ., Philadelphia (USA)). **90**: No. 4, 447-450(Mar 1980).

The theoretical mechanisms for the decays psi' → psi π^0 and psi' → psi eta, which violate SU_2 and SU_3, respectively, are discussed. It is argued that symmetry breaking in the decay amplitudes may be as important as π^0-eta-eta' mixing. The π^0-eta mixing mechanism psi' → psi eta → psi π^0 leads to GAMMA(psi' → psi π^0) = (3.3 +- 1.0) X 10^{-3} GAMMA(psi' → psi eta), but this number may be enhanced by a factor as large as 12 by π^0-eta' mixing and isospin violation in the decay amplitude. The related decays psi → eta γ and psi → eta' γ are also discussed.

9850 (DOE/ER/70004—263) Clustering and hadronization of quarks: a treatment of the low-P/sub T/ problem. Hwa, R.C. (Oregon Univ., Eugene (USA)). Oct 1979. Contract AT06-76ER70004. 46p. (RLO—2230-T4-263). NTIS, PC A03/MF A01.

The low-p/sub T/ problem of hadron fragmentation is treated in the framework of quark model. The basic mechanism of hadronization of quarks is recombination, which is formulated on a firm basis. Clustering of quarks in a hadron is discussed in detail. The quark and antiquark joint distribution is derived systematically with incorporation of QCD ideas wherever possible. Parameters ć scribing the distribution are determined by fitting low-Q^2 electroproduction data. No free parameters are, therefore, involved in the calculation of the pion inclusive distribution in the fragmentation region. The result agrees well with data in both shape and normalization. The formalism can be applied to calculate inclusive distributions of all nucleon - and pion-initiated reactions, while for kaon-

initiated reactions it can be used to extract from low-p/sub T/ data the quark distributions in kaons. 10 figures.

9851 (DOE/ER/70004—266) Quark and gluon decay functions in QCD and recombination model. Change, V.; Hwa, R.C. (Oregon Univ., Eugene (USA)). Apr 1980. Contract AT06-76ER70004. 51p. (RLO—2230-T4-266). NTIS, PC A04/MF A01.

Inclusive longitudinal-momentum distributions of pions in jets initiated by quarks and gluons are determined in perturbative QCD and recombination model. The quark and antiquark joint distributions in jets are first calculated in the leading-order approximation at high Q^2. Gluons in the jets are completely converted to quark pairs. From the overall distribution q anti q pairs with definite quantum numbers then recombine to form pions. The recombination function for the process is well determined in the valon model. No adjustable parameters are involved in these calculations, and no data at low Q^2 are used as phenomenological input. The result for the quark decay functions can be compared with data on e^+e^- annihilation, and the agreement is very good in both shape and normalization. Predictions for the gluon decay functions are presented, but they cannot yet be checked by experiments. The x and Q^2 dependences of both types of decay functions have been parametrized in simple form suitable for use in theoretical and experimental applications. 17 figures, 1 table.

9852 (DOE/ER/70004—271) Transverse momentum distribution of dimuons in the Drell-Yan process. Soper, D.E.; Collins, J.C. (Oregon Univ., Eugene (USA); Illinois Inst. of Tech., Chicago (USA)). 1980. Contract AT06-76ER70004. 4p. (RLO—2230-T4-271). NTIS, PC A02/MF A01.

Recent progress in the theory of the Q/sub T/ distribution in the Drell-Yan process for $0 \leqq$ Q/sub T/$^2 \leqq Q^2$ is described. The basic theoretical result is in transverse position (b) space. How to get from b-space to Q/sub T/-space is discussed in some detail.

9853 (DOE/ER/70004—272) Isospin violation and the decay $F^+ \to \pi^+\pi^0$. Eilam, G. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). Sep 1980. Contract AT06-76ER70004. 8p. (RLO—2230-T4-272). NTIS, PC A02/MF A01.

The decay $F^+ \to \pi^+\pi^0$ can proceed via isospin-violating mechanisms similarly to psi' $\to$ J/psi π^0. It is estimated that π^0 - eta - eta' mixing together with symmetry breaking in the amplitude leads to $\Gamma(F^+ \to \pi^+\pi^0)/\Gamma(F^+ \to \pi^+ \text{eta}) = (2.2 \pm 0.7) \times 10^{-3}$ or $(1.0 \pm 0.3) \times 10^{-3}$, if annihilation processes dominate nonleptonic charmed meson decays. These values correspond to different assumptions for two meson production in F decays.

9854 (DOE/ER/70004—275) Grand unification and proton stability based on a chiral SU(8) theory. Deshpande, N.G.; Mannheim, P.D. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science; Connecticut Univ., Storrs (USA). Dept. of Physics). Jun 1980. Contract AT06-76ER70004. 51p. (RLO—2230-T4-275). NTIS, PC A04/MF A01.

A grand-unified model of the strong, electromagnetic, and weak interactions is presented based on a local SU(8)/sub L/ X SU(8)/sub R/ gauge theory that possesses a global U(8)/sub L/ X U(8)/sub R/ invariance. The model is spontaneously broken by the recently introduced neutrino pairing mechanism, in which a Higgs field that transforms like a pair of right-handed neutrinos acquires a vacuum expectation value. This neutrino pairing breaks the model down to the standard Weinberg-Salam phenomenology. Further, the neutrino pairing causes the two initial global currents of the model, fermion number and axial fermion number, to mix with the non-Abelian local currents to leave unbroken two new global currents, namely, baryon number and a particular lepton number that counts charged leptons and left-handed neutrinos only. The exact conservations of these two resulting currents ensure the absolute stability of the proton, the masslessness of the observed left-handed neutrinos, and the standard lepton number conservation of the usual weak interactions. A further feature of the model is the simultaneous absence of both strong CP violations and of observable axions. The model has a testable prediction, namely, the existence of an absolutely stable, relatively light, massive neutral lepton generated entirely from the right-handed neutrino sector of the theory. 1 table.

9855 (DOE/ER/70004—282) Relativistic description of the Fermi motion effects on deuterium targets. Kusno, D. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). Dec 1979. Contract AT06-76ER70004. 160p. NTIS, PC A08/MF A01.

Thesis.

A comprehensive analysis of the inconsistencies of the conventional, non-relativistic approach, which has been used so far in the extraction of neutron data from deuterium targets, is given. A new approach dealing with the smearing effects, due to the nucleon's Fermi motion inside the deuteron, is developed as an alternative to the conventional one. This new approach is a spin-less, relativistic, simple and consistent approach. A new covariant model of the elastic electromagnetic form factors of the deuteron in the impulse approximation is also presented. The treatment includes spin and allows for a possibility of determining completely the two elastic structure functions.

9856 Fermi-motion effects in deep-inelastic lepton scattering from nuclear targets. Bodek, A.; Ritchie, J.L. (University of Rochester, Rochester, New York 14627). *Physical Review, The, D. Particles and Fields (U. S.);* **23**: No. 5, 1070-1091(1 Mar 1981).

The ratio of deep-inelastic structure functions of nuclear targets to the sum of free neutron and proton structure functions has been calculated, using a modified form of the Atwood-West technique for deuterium. Fermi-gas momentum distributions were used with modifications to include high-momentum tails resulting from nucleon-nucleon correlations. Tables of smearing ratios for W_1, W_2, and W_3 are given as a function of x and Q^2 for deuterium and several heavy nuclei. We find that for $x > 0.5$ the scaling violations for heavy nuclei are smaller than those for free nucleons. The shapes of the antiquark distributions are also changed.

9857 Weak and electromagnetic form factors of baryons at large momentum transfer. Brodsky, S.J.; Lepage, G.P.; Zaidi, S.A.A. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515. *Physical Review, The, D. Particles and Fields (U. S.);* **23**: No. 5, 1152-1157(1 Mar 1981).

Perturbative quantum-chromodynamic predictions are given for the weak and electromagnetic elastic and transition form factors of baryons at large momentum transfer Q. The leading (helicity-conserving) octet and decuplet form factors can all be expressed as linear combinations of the proton and neutron magnetic form factors. The predictions for the spin structure and relative normalization of the baryon form factors reflect the assumed SU(2)/sub L/ x U(1) structure of the electromagnetic and weak currents, quark and gluon hard-scattering dynamics, and the helicity-flavor symmetry of baryon wave functions at short distance. The results hold to all orders in α/sub s/(Q^2) and to leading order in m/Q. We also discuss the special features of the contribution of the end-point $x \sim 1$ region to baryon form factors.

9858 Nonstandard assignments of the tau lepton within SU(2)xU(1). Miller, D.H. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review, The, D. Particles and Fields (U. S.);* **23**: No. 5, 1158-1165(1 Mar 1981).

Within the context of SU(2)xU(1), alternative multiplet assignments for the tau lepton and possible accompanying neutral leptons are investigated. Currently available experimental data is sufficient to rule out many alternatives to the standard assignment of the left-handed tau to a weak-isospin doublet (with massless ν/sub tau/ partner) and the right-handed tau to a singlet.

9859 Gauge-invariant multipole expansion scheme for heavy-quark systems in quantum chromodynamics. Shizuya, K. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review, The, D. Particles and Fields (U. S.);* **23**: No. 5, 1180-1193(1 Mar 1981).

Separation of short-distance and long-distance dynamics for heavy-quark—antiquark systems interacting with color gluons is in-

vestigated through a classification of gluons according to their ranges. A gauge-invariant double multipole expansion scheme is constructed which takes into account color fluctuation of heavy-quark systems. Hadronic transitions between heavy-quark—antiquark bound states as well as the static quark-antiquark potential are studied within this framework.

9860 Quark counting and the production of hyperons. Gaisser, T.K.; Halzen, F. (Bartol Research Foundation, University of Delaware, Newark, Delaware 19711). DE-AC02-76ER00881-173. *Physical Review, The, D. Particles and Fields (U. S.);* **23**: No. 5, 1211-1212(1 Mar 1981).

Recent measurements of the production of hyperons in hadron interactions confirm a previously proposed picture where hadrons are formed by drawing quarks out of the ensemble of quarks and antiquarks produced in the original collision. The data require that the strange quark be heavier, preferring a value for its mass of 0.3 +- 0.05 GeV.

9861 Quantum chromodynamics in $2+\epsilon$ dimensions. Dine, M.; Litwin, C.; McLerran, L. (sectiontanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515. *Physical Review, The, D. Particles and Fields (U. S.);* **23**: No. 2, 451-461(15 Jan 1981).

We consider quantum chromodynamics without quarks, dimensionally continued to $2+\epsilon$ dimensions. Perturbation theory for this model is shown to be highly infrared singular, and the theory, order by order, is not smoothly connected to the two-dimensional theory. We show that with a certain selective resummation of diagrams one can control these divergences, and obtain a structure very similar to that of the 't Hooft model for mesons. The model is then in fact equivalent to the large-N limit of two-dimensional quantum chromodynamics with massless scalar particles in the fundamental representation. The two-gluon bound-state equation which we obtain, however, is itself infrared singular and possesses no normalizable solutions. We discuss this problem in the context of an analog scalar model, and speculate on its possible resolution.

9862 Minimal subconstituent models of quarks and leptons. Casalbuoni, R.; Domokos, G.; Koevesi-Domokos, S. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515;DE-AS-01-76ER03285. *Physical Review, The, D. Particles and Fields (U. S.);* **23**: No. 2, 462-468(15 Jan 1981).

We analyze the structure of composite quarks and leptons in the framework of chiral subconstituent models of minimal internal symmetry. The model of Harari and Shupe contains the correct number of composite fields but it cannot sustain an exact color symmetry. An extension of the Harari-Shupe model is proposed, with both color and electromagnetic properties being realized linearly on the subconstituents. This model contains two generations of quarks and leptons; all models of this type contain additional quarklike states or leptonlike states of higher spin. Problems associated with the implementation of the approximate weak-electromagnetic symmetry and with the statistics of subconstituents are discussed.

9863 θ/sub QCD/ without instantons. Georgi, H.; Tomaras, T.; Pais, A. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). EY-76-C-02-2232B000. *Physical Review, The, D. Particles and Fields (U. S.);* **23**: No. 2, 469-472(15 Jan 1981).

We propose a technique for calculating the quantum-chromodynamic parameter theta-bar/sub QCD/ in theories with soft CP violation. Our method is based on ordinary covariant perturbation theory.

9864 Comment on Riazuddin's weak-interaction model. Ma, E.; Pakvasa, S.; Tuan, S.F. (Department of Physics and Astronomy, University of Hawaii at Manoa, Honolulu, Hawaii 96822). DE-AC03-76ER00511. *Physical Review Letters (U.S.);* **46**: No. 2, 160(12 Jan 1981).

A claim by Riazuddin to have a gauge model of weak interactions based on SU(2) alloys with the same current interactions as the standard SU(2)xU(1) model, but without electroweak unification is disputed. Two flaws in this model make it not a gauge model and, therefore, nor renormalizable.

6453 Particle Invariance Principles And Symmetries

9865 Nonlinear σ model in the loop expansion. Appelquist, T.; Bernard, C. (Department of Physics, Yale University, New Haven, Connecticut 06520). EY-76-C-02-3075. *Physical Review, The, D. Particles and Fields (U. S.);* **23**: No. 2, 425-438(15 Jan 1981).

The nonlinear σ model in four dimensions is discussed in the context of the loop expansion. Since the model is perturbatively nonrenormalizable, divergences not of the form of the Lagrangian are of course expected; what is perhaps surprising is that there are divergences which appear not to be invariant under the original nonlinear symmetry. We demonstrate, however, that these apparently noninvariant terms do not contribute to on-mass-shell quantities and may be eliminated order by order by a field redefinition involving space-time derivatives. The linear σ model is then examined in detail; it is shown how the nonlinear model, including the apparently noninvariant terms, emerges as the limit of the linear model as the σ mass goes to infinity. Finally, we compare our approach with other treatments of the "noninvariant" terms in the nonlinear model.

9866 Reformulation of chiral dynamics in infinite-N/sub c/ quantum chromodynamics. Thorn, C.B. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology,Cambridge, Massachusetts 02139). DE-AC02-76ER03069. *Physical Review, The, D. Particles and Fields (U. S.);* **23**: No. 2, 439-450(15 Jan 1981).

We present a formulation of chiral dynamics suitable for the large-N/sub c/ (number of colors) limit of quantum chromodynamics (QCD). The formulation is in terms of current amplitudes with cyclic crossing symmetry. We derive the chiral Ward identities for these "cyclic current amplitudes" and illustrate how they can be used to obtain low-energy theorems and current-algebra sum rules. We suggest that the Dashen—Gell-Mann program of saturating current-algebra sum rules with narrow resonances be reexamined within the framework of infinite-N/sub c/ QCD. We discuss several possible escapes from no-go results obtained by Chang, Dashen, and O'Raifeartaigh.

9867 CP nonconservation in three-neutrino oscillations. Barger, V.; Whisnant, K.; Phillips, R.J.N. (Physics Department, University of Wisconsin at Madison, Madison, Wisconsin 53706). DE-AC02-76ER00881-177. *Physical Review Letters (U.S.);* **45**: No. 26, 2084-2088(29 Dec 1980).

Direct CP tests in neutrino oscillations require comparison of off-diagonal channels ν/sub α/$\rightarrow\nu$/sub β/ with the CP-conjugate channels nu-bar/sub α/$\rightarrow$nu-bar/sub β/ (or with ν/sub β/$\rightarrow\nu$/sub α/ assuming CPT invariance). For the three-neutrino case, we show that CP-nonconservation effects are identical in all three available channels ν/sub e/bold-arrow-left-rightν/sub μ/, ν/sub μ/bold-arrow-left-rightν/sub tau/, μ/sub tau/bold-arrow-left-rightν/sub e/, and argue that they could be large and measurable in meson factor experiments. Indirect CP tests include the correlation of average probabilities.

6454 Field Theory

REFER ALSO TO CITATION(S) 9839, 9851, 9861, 9863, 9865, 9866

9868 (CONF-800120—6) Migdal approximation in Gribov field theory on a lattice. Tan, C.I. (Brown Univ., Providence, RI (USA). Dept. of Physics). 1980. Contract AC02-76ER03130. 18p. NTIS, PC A02/MF A01.

From Conference on theoretical particle physics; Guangchou, China (5 Jan 1980).

The asymptotic behavior of soft hadronic collisions is studied in the framework of Gribov's field theory for interacting pomerons. An analog model of Ising spins on a lattice with an antihermitian three-spin interaction is constructed. The structure of position space renormalization group analysis appropriate for this classical spin system is discussed, and the existence of a desired nontrivial fixed point is demonstrated in a Migdal approximation. In particular, it is found that the critical index z having a strong coupling value ln3/ln2 approx. = 1.58.

9869 **(DOE/ER/02232—T2) Report of technical progress under the current DOE contract, DOE/EY/2232B.** Beg, M.A.B.; Khuri, N.N.; Pais, A. (Rockefeller Univ., New York (USA)). 1981. Contract AC02-76ER02232. 11p. NTIS, PC A02/MF A01.

Research for the year beginning February 1, 1980 is reviewed. Areas of intrest include mathematical physics and formal results in quantum field theory, gauge theories, and the possibility of observing CP violation in decays of systems other than K mesons. Only brief comments are made; refereces to completed work are given. (RWR)

9870 **(DOE/ER/70004—270) Hadron structure in the ladder model.** Soper, D.E. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). 1979. Contract AT06-76ER70004. 26p. (RLO—2230-T4-270). NTIS, PC A03/MF A01.

The (flavor non-singlet) Green's function to find a far-off-shell quark in a hadron is obtained in the renormalization group improved ladder model for QCD in the space-like axial gauge. Particular attention is paid to the role of the singularity in the gluon propagator. 4 figures.

65 PHYSICS RESEARCH

6510 Nuclear Physics

9871 **(DOE/ER/04215—4) Nuclear structure studies at intermediate energies. Annual progress report, November 1979-October 1980.** Hintz, N.M.; Franey, M.A.; Gazzaly, M.; Cook, D.; Owen, K.; Overacker, L. (Minnesota Univ., Minneapolis (USA). School of Physics). 1980. Contract AS02-77ER04215. 109p. NTIS, PC A06/MF A01.

Research during the period November 1979 through October 1980 is reported. Completed work will be published in the usual places. Three sections containing significant amounts of information are abstracted separately. (RWR)

9872 **(LA—8630-PR) Applied nuclear data research and development. Quarterly progress report, July 1-September 30, 1980.** Baxman, C.I.; Young, P.G. (comps.). (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 40p. NTIS, PC A03/MF A01.

Activities of the Los Alamos Nuclear Data Group for the period July 1 through September 30, 1980 are described. The work fell into three principal categories: theory and evaluation of nuclear cross sections; nuclear cross section processing; and fission products and actinides - yields, decay data, depletion, and buildup. Individual abstracts were prepared for three of the sections in this report. 13 figures, 6 tables. (RWR)

6512 Nuclear Properties And Reaction,a=1-5

9873 **(DOE/ER/10332—1) Investigations of the structure and electromagnetic interactions of few-body systems. Progress report, 1 January 1980-1 October 1980.** (George Washington Univ., Washington, DC (USA)). 7 Nov 1980. Contract AS05-79ER10332. 21p. NTIS, PC A02/MF A01.

Considerable progress has been made on the long-range problems described in the original proposal document (1 February 1979 to 31 January 1980) and on the shorter-range problems described in the last renewal proposal (1 February 1980 to 31 January 1981). This progress concerns few-body structure problems (e.g., the existence of isobar components in ^{3}H, predictions of few-body-hypernuclei properties as a test of hyperon-nucleon interactions, investigation of the A = 6 ground states with exact three-body calculations, and the relation of triton D-state properties to the deuteron's D-state percentage) and electromagnetic properties and interactions of few-body nuclei (e.g., Coulomb effects in calculating and measuring asymptotic normalization constants, and γ + ^{3}He breakup reaction mechanisms at intermediate energies). Descriptions of the progress made indicate where each subject stands at present, and emphasize the significant results obtained. A publication list is attached.

9874 (LA—8303-C, pp 455-456) **Study of the ^{4}He(π^{+-},π^{+-}p)^{3}H reaction at 135 and 174 MeV.** Balestra, F. (Istituto di Fisica dell'Universita, Torino, Italy); Bussa, M.P.; Busso, L. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Events of the π^{+-} + ^{4}He $\rightarrow$ π^{+-} + p + ^{3}H reaction were photographed in a 4-atm self-shunted streamer chamber filled with ^{4}He. The exposures were made with π^- in the (68 to 208) MeV energy interval, and with π^+ in the (68 to 156) MeV interval. Angular and energy distributions obtained at 135 MeV for π^+ and 174 MeV for π^- are presented. 3 figures. (RWR)

9875 **Spin correlation parameter A/sub n/n in pp elastic scattering at 796 MeV.** McNaughton, M.W.; Baer, H.W.; Bevington, P.R.; Cverna, F.H.; Willard, H.B.; Winkelmann, I.; Chamberlin, E.P.; Jarmer, J.J.; King, N.S.P.; Simmons, J.E.; Schardt, M.A.; Willmes, H. (hase Western Reserve University, Cleveland, Ohio 44106). *Physical Review, The, C. Nuclear Physics (U. S.);* **23**: No. 2, 838-844(Feb 1981).

The spin correlation parameter A/sub n/n(θ) for pp elastic scattering has been measured at 796 MeV from 30° to 90° c.m. The typical relative uncertainties of +- 0.01 are almost an order of magnitude better than those of previous data near this energy. The absolute normalization uncertainty is +- 2%. Data are consistent with previous measurements near this energy.

6513 Nuclear Properties And Reactions,a=6-19

REFER ALSO TO CITATION(S) 9155, 9910, 9933, 9933, 9934, 9938

9876 **(LA—8303-C) Workshop on nuclear structure with intermediate-energy probes.** Baer, H.; Moss, J.; Siciliano, E.; Stephenson, G.; Thiessen, H.; Bacher, A.; Bertozzi, W.; Hoffmann, G. (Los Alamos Scientific Lab., NM (USA)). Apr 1980. Contract W-7405-ENG-36. 492p. (CONF-800131—). NTIS, PC A21/MF A01.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

A separate abstract was prepared for 44 of the papers in this volume. The remaining 5 have already been cited in ERA, and may be found by reference to the entry CONF-800131— in the Report Number Index. (RWR)

9877 (LA—8303-C, pp 26-46) **Inelastic proton scattering at medium energy.** Love, W.G. (Univ. of Georgia, Athens). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Some of the most essential characteristics of the nucleon-nucleon interaction for probing nuclear structure at bombarding energies between 100 and 800 MeV are considered. With a local representation of the on-shell N-N t-matrix, data for a variety of specific transitions at IUCF and LAMPF energies are discussed with an emphasis on the nuclear structure information sampled by proton scattering. The importance of incorporating constraints on nuclear structure imposed by electron scattering is stressed. Some rather unique aspects of the (p,n) reaction at intermediate energies are discussed in terms of its energy dependence and nuclear structure sum rules. 11 figures.

9878 (LA—8303-C, pp 57-71) **Neutron/proton states in (π,π').** Morris, C.L. (Univ. of California, Los Alamos). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Recent results for pion inelastic scattering are shown to be consistent with a number of simple predictions, this consistency indicating that pions provide an excellent tool for separating the neutron/proton (isovector/isovector) components of nuclear excitations. This result is used to measure the isospin mixing between states in ^{12}C and ^{16}O. 10 figures, 1 table.

9879 (LA—8303-C, pp 90-98) **Characteristic features of radiative proton capture reactions at intermediate energies.** Blatt, S.L. (Ohio State Univ., Columbus). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Radiative proton capture reactions in the 24 to 100-MeV region show strong transitions to excited states having marked single-particle character. The reactions appear to proceed through giant-resonance-like excitations built upon lower resonances. 6 figures.

9880 (LA—8303-C, pp 119-129) **Neutron/proton radii from low energy pion scattering.** Alster, J. (Tel Aviv Univ., Ramat Aviv, Israel). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

The measurement of low-energy π^- elastic scattering from neighboring nuclei can serve to determine the difference in neutron radii for these isotopes. This is demonstrated for the nuclei ^{12} ^{13}C and ^{16} ^{18}O. The method can be tested by measuring low energy π^+ elastic scattering from a pair of isotones such as ^{11}B and ^{12}C. By combining the results with electron scattering data it is possible to obtain accurate values for differences between neutron and proton radii in one nucleus in terms of the difference of neutron and proton radii in the nearby N = Z nucleus. 5 figures, 1 table.

9881 (LA—8303-C, pp 195-207) **(π^+,π^-) double charge exchange.** Burleson, G.R. (New Mexico State Univ., Las Cruces). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Recent data on (π^+,π^-) double charge exchange scattering on various nuclei are presented, the observed systematics are discussed, and comparisons are made to recent theoretical calculations. The data include information on angular distributions, excitation functions, and variation of small-angle cross sections with atomic number. 15 figures.

9882 (LA—8303-C, pp 208-219) **Recent developments in (p,π).** Bent, R.D. (Indiana Univ. Cyclotron Facility, Bloomington). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

New data on the energy, mass and state dependence of the (p,π^{+-}) and (→p,π^+) reactions near threshold (T/sub p/ ≦ 200 MeV) are presented. The extent to which the data can be explained by the DWBA Stripping Model is discussed. 9 figures.

9883 (LA—8303-C, pp 220-232) **(→p,2p) and (→p,d) reactions.** Hutcheon, D.A. (TRIUMF, Vancouver, Canada). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Asymmetries seen in the proton knockout reaction (→p,2p) and the neutron pickup reaction (→p,d) at intermediate energies show marked dependence on whether the removed nucleon had j = l - 1/2 or j = l + 1/2. For each reaction a simple physical explanation of the j dependence is presented, then some of the available data are shown and compared with DWIA or DWBA calculations. The emphasis is on spectroscopic applications, rather than reaction mechanisms (to the extent that this is possible). In conclusion, directions for future measurements with these reactions are suggested. 11 figures. (RWR)

9884 (LA—8303-C, pp 233-248) **Coherent pion production from nuclei at threshold.** Gibbs, W.R. (Univ. of California, Los Alamos). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

A summary is given of present difficulties in the understanding of the coherent production of low-energy pions. It is pointed out that pion production from the nuclear pionic field has qualitative features very similar to the experimental observations. First results of a DWIA calculation of this process are shown to study these qualitative features. 16 figures, 1 table.

9885 (LA—8303-C, pp 252-262) **Recent results in kaon scattering and strangeness exchange on nuclei.** Hungerford, E.V. III. (Univ. of Houston, TX). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

A brief review of the present status of kaon scattering and strangeness exchange reactions on nuclei is developed with emphasis on what is now known or assumed about these reactions. Questions in interpretation or inconsistencies in the data are pointed out. Some of these problems can be resolved with the existing beams and spectrometers, but to obtain the full potential of kaon reactions new beams and facilities are needed. 7 figures, 3 tables.

9886 (LA—8303-C, pp 278-285) **Asymmetries in π^+ vs. π^- inelastic scattering resulting from continuum effects.** Siciliano, E.R.; Weiss, D.L. (Univ. of California, Los Alamos). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Microscopic distorted-wave impulse-approximation calculations of pion inelastic scattering to stretched states of light even-even nuclei are discussed. Attention is focused upon the effects that result from the use of continuum single-particle wave functions. An enhancement of the π^- nuclear response over the π^+ is found for both the T = O and T = 1 states, throughout the intermediate-energy region. A simple formula for understanding these results is presented. 5 figures.

9887 (LA—8303-C, pp 286-291) **Theoretical study of hypernuclear formation using the (π^+,K$^+$) reaction.** Ludeking, L.D.; Walker, G.E. (Indiana Univ., Bloomington). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

The DWIA and the eikonal approximation for distortions were used to study the differential cross sections associated with the formation of [(n'l'jl)A(nlj)$^{-1}$]J/sup π/hypernuclear states in the (π^+,K$^+$) reactions. In the region 0.80 GeV/c < P/sub π/(LAB) ≦ 1.645 GeV/c the (π^+,K$^+$) reaction involves large momentum transfer q ≧ 300 MeV/c at 0^0. Thus, even at forward angles, relatively high-spin normal-parity states dominate the reaction excitation spectrum. The behavior of the response function as a function of A and the complementarity of the process to (K$^-$,π^-) reaction are discussed. For light nuclei, forward cross sections of the order of 10 μb are not uncommon, and, therefore, the study of this reaction appears feasible at the Brookhaven ZGS. 3 figures.

9888 (LA—8303-C, pp 295-305) **^{12}C(e,e'p) coincidence measurements in the region of the giant electric dipole resonance.** Calarco, J.R.; Arruda-Neto, J.; Griffioen, K. (Stanford Univ., CA). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Electrons with an incident energy of 86 MeV were inelastically scattered from ^{12}C at 40^0, and protons emitted by ^{12}C with E/sub ex/ between 20 and 26 MeV were studied as a function of angle. The dominant feature in the inelastic scattering spectrum is the giant electric dipole resonance. From these studies the branching ratio for decay of the giant resonance to excited states in ^{11}B was determined. Preliminary evidence for excitation of the spin flip component of the giant resonance in ^{12}C was found. 8 figures.

9889 (LA—8303-C, pp 322-327) **Excitation of unnatural parity states in light nuclei by 800 MeV polarized protons.** Glashausser, C. (Rutgers Univ., New Brunswick, NJ); Moss, J.M.; Baker, F.T. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Cross sections and analyzing powers have been measured at 800 MeV for inelastic proton excitation of unnatural-parity states in ^{6}Li, ^{12}C, and ^{14}N at small momentum transfer. Cross sections are comparable in magnitude with those measured at lower energies. Negative analyzing powers observed for the first time at 800 MeV appear characteristic of unnatural-parity transitions with no isospin transfer. 5 figures.

9890 (LA—8303-C, pp 328-330) **Energy dependence of inelastic pion scattering from ^{13}C.** Tripp, S.J. (Univ. of Minnesota, Minneapolis); Dehnhard, D.; Franey, M.A.; Kyle, G.S.; Morris, C.L.; Boudrie, R.L.; Piffaretti, J.; Thiessen, H.A. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Excitation functions have been measured for inelastic scattering of pions from ^{13}C at five incident pion energies between 116 and 240 MeV. The energy dependence of the pure neutron transition to the 9.5 MeV state strongly supports the previous spin and parity assignment of $9/2^+$, and demonstrates the usefulness of pion inelastic scattering in the identification of transitions that proceed by spin-flip. 1 figure.

9891 (LA—8303-C, pp 336-351) **Elementary excitations involving spin flip studied in ^{13}C and ^{20}Ne by the (π^-,γ) reaction.** Martoff, C.J. (Lawrence Berkeley Lab., CA); Bistirlich, J.A.; Crowe, K.M. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Questions in the nuclear physics of ^{20}Ne and ^{13}C have been addressed by analysis of the energy spectra of hard γ rays (50 MeV $<$ E/sub γ/ $<$ 135 MeV) resulting from the nuclear capture of stopped π^- in these targets. The energy resolution of 850 keV achieved in these spectra greatly aids in the extraction of matrix elements involving single final nuclear states. Quantitative comparisons with backward inelastic electron scattering measurements, the analog β decay of ^{13}B, and photonucleon spectroscopy are made. These confirm the established theoretical treatment of transitions to bound states. New information is gained on the mechanism of the giant M1 transition observed at 11.24 MeV excitation in ^{20}Ne. Comparison is made to a harmonic oscillator shell model calculation of the ^{13}C(π^-,γ) spectrum. 10 figures, 2 tables.

9892 (LA—8303-C, pp 392-401) **Coincidence measurements of the reactions ^{12}C$(\pi^{+-},\pi^{+-}$d$)^{10}$B and ^{12}C$(\pi^{+-},\pi^{+-}$t$)^{9}$B.** Ellis, R.J. (Univ. of Virginia, Charlottesville); Ziock, H.J.; Ziock, K.O.H.; Bolger, J.; Boschitz, E.; Arvieux, J.; Corfu, R.; Piffaretti, J. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

The reactions ^{12}C$(\pi^{+-},\pi^{+-}$d$)^{10}$B and ^{12}C$(\pi^{+-},\pi^{+-}$t$)^{9}$B were measured at an incident pion energy of 180 MeV, with two spectrometers in coincidence. The ratio $\sigma(\pi^+,\pi^+$d$)/\sigma(\pi^-,\pi^-$d$)$ agrees with the isospin prediction of unity. There is evidence for quasi-elastic πd scattering. The surprising result is obtained that the ratio $\sigma(\pi,\pi$d$)/\sigma(\pi,\pi$p$)$, for excitation energies less than 10 MeV, is equal to the ratio $d\sigma/d\Omega$ $(\pi$d$)/d\sigma/d\Omega(\pi$p$)$ for elastic $(\pi$d$)$ and $(\pi$p$)$ scattering at all the points measured. The ratio $\sigma(\pi^-,\pi^-$t$)/\sigma(\pi^+,\pi^+$t$)$ is approximately one, and there is no evidence for quasi-elastic πt scattering. 5 figures, 3 tables.

9893 (LA—8303-C, pp 423-429) **π^0-photoproduction in the isobar-doorway model.** Saharia, A.N.; Woloshyn, R.M. (TRIUMF, Vancouver, Canada). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Many-body modifications to the photoproduction operator are discussed in the isobar-doorway mode
done for ^{12}C$(\gamma,\pi^0)^{12}$C for two different parametrizations of the isobar-doorway model and are found to differ substantially, even though they fit elastic scattering equally well. 4 figures.

9894 (LA—8303-C, pp 430-438) **Pion double charge exchange - recent data.** Greene, S.J. (Univ. of Texas, Austin); Braithwaite, W.J.; Holtkamp, D.B.; Cottingame, W.B.; Moore, C.F.; Burleson, G.R.; Blanpied, G.S.; Morris, C.L.; Thiessen, H.A. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Pion double charge exchange transitions (π^+,π^-) have been studied to double isobaric analog and nonanalog states. Data are reported from a systematic study of the reaction on the nuclei ^{16,18}O and ^{24,26}Mg. Preliminary analysis for analog transitions is reported. Use of the technique for mass measurements is also discussed. 7 figures, 1 table.

9895 (LA—8303-C, pp 439-442) **Global fits of pion elastic scattering from ^{12}C and ^{16}O across the (3,3) resonance.** Holtkamp, D.B.; Cottingame, W.B. (Univ. of Texas, Austin). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Calculations of π^{+-} elastic scattering from ^{12}C between 120 and 280 MeV indicate that vastly improved fits to the data are obtained when a shift of the energy at which the optical model parameters are evaluated of -25 +- 3 MeV is included. Similar fits for π^{+-} elastic scattering from ^{16}O between 114 and 240 MeV yield a shift of -22 +- 4 MeV. A tentative explanation in terms of binding effects is presented. 1 figure.

9896 (LA—8303-C, pp 443-447) **Differential cross sections for ^{16}O$(\gamma,\pi^+)^{16}$N and ^{10}B$(\gamma,\pi^+)^{10}$Be in the Δ(1236) region.** Bosted, P.E.; Blomqvist, K.I.; Bernstein, A.M.; Dytman, S.A. (Massachusetts Institute of Technology, Cambridge). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

The first (γ,π) experiment to discrete final states in the Δ(1236) region is reported. Differential cross sections for ^{10}B$(\gamma,\pi^+)^{10}$Be and ^{16}O$(\gamma,\pi^+)^{16}$N have been measured at 90^0 laboratory angle for 80- to 200-MeV kinetic energy pions. The contributions from the ground and first excited states in ^{10}Be were observed separately, while in ^{16}N the sum of the four lowest-lying states was observed. The data are found to be in good agreement with DWIA calculations for ^{10}B; one calculation agrees for ^{16}O, while another is a factor of two low. 2 figures.

9897 (LA—8303-C, pp 448-454) **Study of strong spin-isospin mode analog states at 4.5 MeV in ^{12}B in ^{12}C$(e,\pi^+)^{12}$B.** Min, K. (Rensselaer Polytechnic Institute, Troy, NY); Winhold, E.J.; Shoda, K.; Tsubota, H.; Ohashi, H.; Yamazaki, M. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Strong spin-isospin mode analog states at 4.5 MeV in ^{12}B were studied by the reaction ^{12}C$(e,\pi^+)^{12}$B. The double differential cross sections for the reaction ^{12}C$(e,e'\pi^+)^{12}$B leading to the 4.5-MeV T = 1, T/sub Z/ = 1 complex in ^{12}B were measured at the electron energy E/sub e/ = 200 MeV with the aid of the Tohoku electron linear accelerator at θ/sub π/ = 30^0, 50^0, 70^0, 90^0, 110^0, 130^0 and 150^0. The corresponding momentum transfer ranged from about 0.6 to 1.5 fm^{-1}. The photoproduction cross sections were obtained from virtual photon theory and an experimentally determined real-to-virtual photon ratio. The results are compared with theoretical calculations and also with the available data on inelastic electron scattering from the 19.5 MeV T = 1, T/sub Z/ = 0 analog complex in ^{12}C. 4 figures.

9898 (LA—8303-C, pp 457-460) **Possible effects of dibaryon resonances on pion double charge exchange.** Braithwaite, W.J. (Univ. of Texas, Austin); Moore, C.F.; Greene, S.J.; Morris, C.L.; Cottingame, W.B. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

$^3S_1$ dibaryon resonances, formed by p-wave π^+ absorption on valence $^1S_0$ neutron pairs, are proposed as a possible source of the measured strong dominance of double-analog transitions over non-analog transitions in low-A double charge-exchange reactions, at incident pion energies well above the (3,3) pion-nucleon resonance. 4 figures.

9899 (LA—8303-C, pp 461-479) **Some results of a comparison of electron and 135 MeV proton scattering from the oxygen isotopes.** Kelly, J. (Massachusetts Institute of Technology, Cambridge); Bertozzi, W.B.; Buti, T. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

New IUCF elastic and inelastic 135-MeV proton scattering data are presented. The data are examined within the framework of the impulse approximation using recent MIT-Bates electron-scattering proton densities. A reasonable description of the general trends in the data is obtained with this approach, and strong sensitivity to

neutron radius differences is exhibited. Some density-dependent interaction effects are discussed. 10 figures, 3 tables.

9900 Two-nucleon processes in a coupled-channel approach to pion-nucleus single-charge-exchange reactions. Liu, L.C. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review, The, C. Nuclear Physics (U. S.);* **23**: No. 2, 814-827(Feb 1981).

A momentum space coupled-channel formalism is proposed for the study of pion-nucleus single-charge-exchange reactions at medium energies. Formal elimination of certain reaction channels leads to a reduced set of coupled equations with a complex and energy-dependent interaction. A nonperturbative method based upon unitarity considerations is then used to construct each order of this effective pion-nucleus interaction. Our analysis thus leads to a second-order pion-nucleus interaction with analytical properties very different from those obtained from multiple-scattering theory. The theory is applied to the study of pion-^{13}C elastic scattering and the single-charge-exchange reaction $^{13}C(\pi^+,\pi^0)^{13}N$(g.s.). Included in our calculations are the first- and second-order pion-nucleus strong interactions, and the pion-nucleus Coulomb interaction. We have calculated the first-order interaction using a covariant, nonstatic theory and have evaluated contributions to the second-order interaction arising from two-nucleon processes related to true pion absorption and to the scattering of pions from a nucleon pair. We present a general relation connecting the second-order pion-nucleus strong interaction potentials of nuclei whose structure do not differ appreciably. Theoretical results for π^{13}C elastic scattering predicted by our theory are found to be in good agreement with the data. The calculated excitation function of the single-charge-exchange reaction exhibits a high sensitivity to the type of two-nucleon processes considered. Pion-nucleus single-charge-exchange reactions therefore have promise as a tool for investigating pion-nucleus reaction mechanisms.

9901 Observation of the direct and sequential breakup of ^{7}Li from ^{12}C and ^{208}Pb targets at 70 MeV. Shotter, A.C.; Bice, A.N.; Wouters, J.M.; Rae, W.D.; Cerny, J. (Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). W-7405-ENG-48. *Physical Review Letters (U.S.);* **46**: No. 1, 12-15(5 Jan 1981).

A study has been made of the breakup of 70-MeV ^{7}Li into the α+t channel. For reactions on a ^{12}C target the ^{7}Li breakup proceeds sequentially through its 4.63-MeV, 7.2$^-$ state. For reactions on a ^{208}Pb target, there is evidence both for sequential breakup and for an additional breakup process which does not proceed through an excited state of ^{7}Li. This latter process is attributed to direct projectile breakup in the nuclear field of the target.

9902 Energy dependence of pion elastic scattering from nuclei across the (3,3) resonances. Cottingame, W.B.; Holtkamp, D.B. (University of Texas, Austin, Texas 78712). *Physical Review Letters (U.S.);* **45**: No. 23, 1828-1831(8 Dec 1980).

Improved agreement between calculation and π^{+-} elastic-scattering data across the (3,3) resonance is obtained by assuming the π-nucleon collision energy, ω, to be $\cong$30 meV less than the incident pion energy. This effect has been observed for nuclei ranging from ^{9}Be to ^{208}Pb.

9903 Coupled-channels calculations of intermediate energy πi-^{13}C inelastic scattering and charge exchange. Chakravarti, S. (Argonne National Lab., IL (USA); Chicago Univ., IL (USA)). **90**: No. 4, 350-353(Mar 1980).

Coupled-channels calculations have been carried out for pion inelastic scattering and charge exchange on 1p-shell nuclei at pion energies between 120 and 226 MeV. A momentum space technique is used, with the 1p-shell shell-model wavefunctions of Cohen and Kurath. Results are presented here for A = 13. Channel-coupling effects are negligible in the strong 3/2$^-$ and 5/2$^-$ inelastic excitations of ^{13}C, but enhance the analog charge-exchange cross sections by 7 to 20%.

6514 Nuclear Properties And Reactions, A=20-38

9904 (DOE/ER/04215—4, pp 5, 49, 57-59) **Proton scattering on 2s-1d shell nuclei at 800 MeV.** 1980.

In Nuclear structure studies at intermediate energies. Annual progress report, November 1979-October 1980.

Final differential cross sections are reported for ^{24}Mg and ^{26}Mg. Results of coupled-channels calculations are shown. 3 figures, 1 table. (RWR)

9905 (DOE/ER/04215—4, pp 12-14, 53, 81-88) **Inelastic scattering at 500 and 333 MeV.** 1980.

In Nuclear structure studies at intermediate energies. Annual progress report, November 1979-October 1980.

Proton spectra from bombardment of ^{28}Si, ^{58}Ni, and ^{208}Pb are shown. Cross sections are given for ^{208}Pb; ratios, for ^{28}Si. 8 figures, 1 table. (RWR)

9906 Decays of the T/sub z/=-2 nuclei ^{20}Mg, ^{24}Si, and ^{36}Ca. Aystoe, J.; Cable, M.D.; Parry, R.F.; Wouters, J.M.; Moltz, D.M.; Cerny, J. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review, The, C. Nuclear Physics (U. S.);* **23**: No. 2, 879-887(Feb 1981).

Beta-delayed protons have been observed from the decays of the mass separated T/sub z/=-2 nuclides ^{20}Mg, ^{24}Si, and ^{36}Ca. From these proton spectra the mass excesses of the lowest T=2 states in the T/sub z/=-1 nuclei ^{20}Na, ^{24}Al, and ^{36}K are determined to be 13420 +- 50 keV (^{20}Na), 5903 +- 9 keV (^{24}Al), and -13168 +- 22 keV (^{36}K). The complete A=20, 24, and 36 isospin quintets have all their members bound against isospin allowed particle-decay modes, providing a stringent test of the isobaric multiplet mass equation. Good agreement is observed for all these quintets using only the quadratic form of this equation.

9907 Nonresonant behavior of the yield of the ^{28}Si 2$^+$ (E/sub x/=1.78 MeV) state via the ^{12}C+^{28}Si reaction. Vandenbosch, R.; Lock, D.; Lazzarini, A.J.; Lesko, K.; Metag, V. (University of Washington, Seattle, Washington 98195). *Physical Review Letters (U.S.);* **46**: No. 1, 5-7(5 Jan 1981).

α-ray techniques have been used to measure the total cross section for populating the 1.78-MeV 2$^+$ state in ^{28}Si via the ^{12}C+^{28}Si reaction at E/sub c.m./=23—35 MeV. Unlike the highly structured back-angle elastic and inelastic scattering excitation functions, the integrated inelastic yield is found to vary smoothly with energy. The absence of structure in the total inelastic cross section does not support a resonance interpretation of the back-angle particle scattering data.

6515 Nuclear Properties And Reactions,a=39-58

REFER ALSO TO CITATION(S) 9878, 9882, 9883, 9887, 9902, 9905, 9916, 9934, 9937, 9938

9908 (LA—8303-C, pp 130-150) **Elastic scattering near the (3,3) resonance.** Johnson, M.B. (Los Alamos Scientific Lab., NM). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Elastic scattering of π^{+-} from nuclei is discussed in a semiclassical framework. Analytical formulas are presented and compared to exact computer solutions of the scattering theory. Recent data from the EPICS spectrometer on π^{+-} scattering from ^{40}Ca, ^{42}Ca, ^{44}Ca, and ^{48}Ca are examined from the semiclassical point of view. The theory gives a good overall reproduction of the data, but in order to understand certain details it is found necessary to introduce an energy shift of approximately -20 MeV in the evaluation of the free pion-nucleon scattering amplitude, and to add isotopic spin-dependent terms that are quadratic in the nuclear density. Evaluations of the scattering are made by use of mean-field DME Hartree-Fock densities, and it is observed that the size of the neutron halo increases too rapidly from ^{40}Ca to ^{48}Ca in the theory. The importance of single and double charge exchange experiments is emphasized as necessary for understanding of the isotopic spin dependence of the pion-nucleus interaction. 7 figures, 6 tables.

9909 (LA—8303-C, pp 151-165) **Matter distributions from pionic atoms.** Powers, R.J. (California Inst. of Technology, Pasadena). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Recent precise measurements of pionic atom strong interaction (SI) effects are used to determine the pion-nuclear potential. This potential is then used to explore the sensitivity of pionic atom SI effects to neutron radii. The consistency of these neutron radii with Hartree-Fock calculations and the results from other hadronic probes are discussed. 2 figures, 8 tables.

9910 (LA—8303-C, pp 189-194) **Systematics of (π^+,π^0) charge exchange reactions.** Doron, A. (Tel Aviv Univ., Israel). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Measurements of the 6° differential cross sections from (π^+,π^0) single charge exchange reactions on different nuclei at 180 MeV are presented with emphasis on the isospin dependence of the cross sections. The very preliminary results behave according to (N-Z)A/sup -4/3/. Use of realistic nuclear densities in the calculations of Johnson and Siciliano cause small deviations from this functional behavior. Large deviations from this behavior may indicate special nuclear structure effects. 3 figures.

9911 (LA—8303-C, pp 311-321) **Large angle elastic and inelastic scattering of protons from ^{40}Ca at 800 MeV.** Adams, G. (Univ. of California, Los Angeles); Bleszynski, E.; Bleszynski, M. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Differential cross sections and analyzing powers of elastic and inelastic scattering of 800-MeV protons have been measured. The data for the differential cross sections cover a considerably large angular range - up to 42.50 in the center-of-mass frame. Regular diffraction pattern in the angular distributions was obtained at all angles. These features are very well understood qualitatively and reproduced quantitatively in the framework of the multiple scattering theory based on the Glauber model. In the calculations spin effects were included for both elastic and inelastic processes. The center-of-mass constraint was taken into account. The Coulomb effects were treated by means of the method of Faeldt and Hulthage. In the case of elastic scattering noneikonal corrections were calculated with the technique of Bleszynski and Osland. 2 figures.

9912 (LA—8303-C, pp 411-417) **Relativistic optical model and the Coulomb correction term.** Arnold, L.G. (Ohio State Univ., Columbus); Clark, B.C.; Mercer, R.L. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

A relativistic optical potential based on meson exchange theory of the two-nucleon interaction is employed in calculating the Coulomb correction term for ^{40}Ca. 3 figures, 1 table.

9913 **Proton elastic scattering from /sup 40,42,44,48/Ca at 800 MeV.** Ray, L.; Hoffmann, G.W.; Barlett, M.; McGill, J.; Amann, J.; Adams, G.; Pauletta, G.; Gazzaly, M.; Blanpied, G.S. (Department of Physics, The University of Texas, Austin, Texas 78712). *Physical Review, The, C. Nuclear Physics (U. S.);* **23**: No. 2, 828-837(Feb 1981).

New and/or corrected 800 MeV p+/sup 40,42,44,48/Ca elastic angular distributions are presented. The data, together with analyzing power measurements, are analyzed to investigate the isotopic neutron and matter density differences between these four calcium isotopes. The analysis employs a local, spin-dependent form of the second order Kerman, McManus, and Thaler optical potential in which approximately model-independent forms for the neutron densities are assumed. Nucleon-nucleon amplitude uncertainties which occur at 800 MeV are taken into account in determining the empirical isotopic density differences. The deduced neutron and matter density differences are compared to the results of other intermediate energy proton and alpha particle scattering analyses and to Hartree-Fock predictions. The various empirical results are generally in good agreement with each other and with the Hartree-Fock predictions, except for ^{48}Ca where the results obtained here and elsewhere suggest that the ^{48}Ca neutron excess is not distributed at quite as large a radius as predicted by Hartree-Fock theory.

9914 **Exotic heavy-ion reactions on ^{40}Ca: (^{14}C,^{14}O) double charge exchange and (^{14}C,^{15}O) rearrangement transfer.** Drake, D.M.; Moses, J.D.; Peng, J.C.; Stein, N.; Sunier, J.W. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters (U.S.);* **45**: No. 22, 1765-1769(1 Dec 1980).

Double charge exchange is observed for the first time with heavy ions by using the reaction ^{40}Ca(^{14}C, ^{14}0)^{40}Ar at 51 MeV incident energy. Angular distributions for the rear-rangement-transfer reaction ^{40}Ca(^{14}C, ^{15}0)^{39}Ar were also measured, and both exotic reactions are compared with the more usual one- and two-proton transfer reactions (^{14}C, ^{15}N) and (^{14}C, ^{16}0). Cross sections for the exotic processes are surprisingly large: α10 μb/sr for (^{14}C, ^{14}0) and ~200 μb/sr for (^{14}C, ^{15}0).

6516 Nuclear Properties And Reactions,a=59-89

9915 **(COO—2439-7) Measurement and analysis of neutron cross sections with the Oak Ridge Linear Accelerator Neutron Facility. Progress report, April 1, 1980-March 31, 1981.** Garg, J.B. (State Univ. of New York, Albany (USA). Dept. of Physics). Nov 1980. Contract AS02-76ER02439. 15p. NTIS, PC A02/MF A01.

The research involved the measurement, analysis, and interpretation of high-resolution neutron total and capture cross sections in the neutron energy range of few eV to few hundred keV with many nuclei. The extensive measurements of total and capture cross section in many nuclei (^{64}Zn, ^{66}Zn, ^{67}Zn, ^{68}Zn, ^{70}Zn, ^{57}Fe, ^{58}Fe) have been analyzed with an R-matrix multilevel multichannel code for the total cross section and LSFIT code for the capture cross sections. The results of these analyses have been reported. The measurements of total and capture cross section in nuclei also provide valuable data for nucleosynthesis of elements, and a better understanding of the neutron interaction with nuclei. These measurements in certain nuclei are equally important for their application in the reactor design. Some effort was also spent in modifying various computer programs of data transfer, and area and shape analysis of neutron total cross section data. Research results are sketched, and references are given to completed papers.

9916 (LA—8303-C, pp 388-391) **Stretched M8 transitions in ^{60}Ni.** Plum, M. (Univ. of Massachusetts, Amherst); Lindgren, R.A.; Hicks, R.S.; Parker, B.; Peterson, G.A.; Williamson, C.F. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

An inelastic spectrum from 205.1-MeV electron bombardment of ^{60}Ni is shown. The transverse form factor squared for two of the candidate (g/sub 9/2/f/sub 7/2/$^{-1}$) 8$^-$ states is plotted. A summary of measured relative M8 strength presently identified for 8$^-$ states in ^{54}Fe, ^{58}Ni, and ^{60}Ni is given. The transverse form factor squared for the 13.263-MeV state in ^{54}Fe is compared with a calculated form factor assuming a (g/sub 9/2/f/sub 7/2/$^{-1}$) configuration using harmonic oscillator radial wave functions.

9917 **Neutron widths and level spacings of ^{64}Zn+n.** Garg, J.B.; Tikku, V.K.; Harvey, J.A. (State University of New York at Albany, Albany, New York 12222). *Physical Review, The, C. Nuclear Physics (U. S.);* **23**: No. 2, 671-682(Feb 1981).

High resolution neutron total cross-section measurements on the separated isotope ^{64}Zn have been made in energy range of few eV to about 370 keV using a pulsed neutron time-of-flight technique with a nominal resolution of 0.07 ns/m. We have analyzed the cross section data up to 370 keV using a multilevel multichannel computer code and obtained values of the resonance parameters (E_o, J/sup π/, gΓ/sub n/). From these results we obtain the following values for the average properties of the resonance parameters: <D>/sub l/=03.59=(plus-or-minus0.16) keV, S_0(x 10^4)=1.89 +- 0.26, and S_1(x 10^4)=0.59 +- 0.06. We have also investigated the neutron width and nearest neighbor spacing distributions for 103 s-

wave resonances up to 370 keV. The neutron width distribution follows a chi-squared distribution with $\nu=1.15 +- 0.30$. We have determined values for Dyson-Mehta's Δ_3 statistic for s-wave levels up to 300 keV as a function of energy. These are found to be in excellent agreement with the predicted values as explained in Table V. Similarly the linear coefficient of correlation between nearest neighbor spacings gives a value of rho=-0.35 in agreement with the predicted value of the random matrix model. The value for the mean p-wave level spacing is larger than expected from the (2J+1) density law, indicative of missed p-wave levels.

9918 Neutron capture cross section in ^{64}Zn. Garg, J.B.; Tikku, V.K.; Halperin, J.; Macklin, R. (State University of New York, Albany, New York 12222). *Physical Review, The, C. Nuclear Physics (U. S.);* **23**: No. 2, 683-694(Feb 1981).

Total neutron capture cross section measurements of the separated isotope of $^{64}_{30}$Zn have been made in the energy interval of 2.5—900 keV. These were made using time-of-flight techniques and a total energy γ-ray detector system with a nominal resolution of about 0.12 ns/m. Resonance energies and capture areas were determined for 191 resonances up to 131 keV. Values of the radiation widths and neutron widths for many resonances have been determined making use of the results available from transmission measurements. From these results mean values of <Γ/sub γ/ >726=(plus-or-minus60) meV for s-wave and <Γ/sub γ/ >272=(plus-or-minus30) meV for p-wave resonances have been determined. A value for the p-wave strength function $S_1$0.75=(plus-or-minus0.08) x 10^{-4} eV/sup -1/2/ was obtained for neutron energy up to 130 keV. Bayes' theorem for conditional probability was used to identify d-wave levels and from these resonances a lower limiting value for d-wave strength function $S_2$0.78=(plus-or-minus0.12) x 10^{-4} eV/sup -1/2/ was obtained. The values for the p-wave mean level spacing for all resonances observed up to 130 keV, and after elimination of d-wave resonances, were found to be (0.68 +- 0.04) and (1.10 +- 0.07) keV, respectively. An analysis of the linear correlation coefficient (rho) between Γ°/sub n/ and Γ/sub γ/ gave a value of (0.47 +- 0.08) at a confidence level of 99.7%.

9919 Charged-particle emission in reactions of 15-MeV neutrons with ^{89}Y, ^{90}Zr, and /sup 92,94,95,96/Mo. Haight, R.C.; Grimes, S.M.; Johnson, R.G.; Barschall, H.H. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review, The, C. Nuclear Physics (U. S.);* **23**: No. 2, 700-707(Feb 1981).

Charged-particle emission cross sections, spectra, and angular distributions have been measured for targets of ^{89}Y, ^{90}Zr, and /sup 92,94,95,96/Mo bombarded with 14.8-MeV neutrons. A magnetic quadrupole spectrometer served to detect the charged particles. Evidence for both statistical and pre-equilibrium reaction mechanisms was found in the proton, deuteron, and alpha-particle emission. The cross sections and spectra are compared with calculations based on these reaction models.

6517 Nuclear Properties And Reactions,a=90-149

9920 (DOE/ER/01388—464) Correlation of aligned angular momentum with scattering angle and energy loss in deeply inelastic collisions. Lazzarini, A.; Metag, V.; Seamster, A.G.; Vandenbosch, R.; Loveman, R. (Washington Univ., Seattle (USA)). 1980. Contract AC06-76ER01388. 12p. NTIS, PC A02/MF A01.

γ-ray in-plane to out-of-plane anisotropy and multiplicity are determined for the ^{100}Mo + ^{165}Ho reaction at E/sub cm/ = 450 MeV. The measurements are made as functions of Q-value and θ/sub cm/ for the coincident quasi or deeply inelastically scattered ions. Strong correlations of the aligned angular momentum with both energy loss and scattering angle are observed.

9921 (DOE/ER/04215—4, pp 8-10, 51-52, 69-79) Search for Orbit Flip States in ^{90}Zr, ^{120}Sn, ^{144}Sm, and ^{208}Pb. 1980.

In Nuclear structure studies at intermediate energies. Annual progress report, November 1979-October 1980.

Differential cross sections for proton elastic and inelastic scattering at 800 MeV are presented. Analysis was by optical model and DWBA. 11 figures, 1 table. (RWR)

9922 (LA—8303-C, pp 99-118) Neutron density distributions from 800 MeV proton-nucleus elastic scattering. Hoffmann, G.W. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

After a discussion of the expected sensitivity of 800-MeV p + nucleus elastic scattering cross section and analyzing power data to the details of the target neutron density distribution, the results of microscopic analyses are discussed. Particular emphasis is given to the uncertainty in the deduced neutron density information arising from various experimental and theoretical uncertainties. 25 figures, 4 tables.

9923 Level schemes of ^{102}Pd and ^{100}Pd. Piel, W.F. Jr.; Scharff-Goldhaber, G.; Lumpkin, A.H.; Lee, Y.K.; Stromswold, D.C. (Brookhaven National Laboratory, Upton, New York 11973). DE-AC02-76CH00016. *Physical Review, The, C. Nuclear Physics (U. S.);* **23**: No. 2, 708-732(Feb 1981).

High-spin states have been populated in ^{102}Pd by ^{92}Zr(^{13}C,3nγ)^{102}Pd with E/sub lab/=56 MeV and in ^{100}Pd by ^{91}Zr(^{13}C,3nγ)^{100}Pd with E/sub lab/=63 MeV. We find in each nuclide a ground-state band (ΔJ=2) of positive parity extending to J/sup π/=14^+, as well as two negative parity bands (ΔJ=2), one of odd spin and one of even spin. For ^{100}Pd, the present level scheme represents the first definitive study of excited states in this nuclide. For ^{102}Pd the present data include the first measurement of the γ-ray linear polarizations. The level energies are compared to the variable moment of inertia model, the interacting boson approximation model, and to the results of a quasiparticle calculation.

9924 Neutron emission in deeply-inelastic collisions of ^{16}O on ^{93}Nb at 204 MeV. Gavron, A.; Ferguson, R.L.; Obenshain, F.E.; Plasil, F.; Young, G.R.; Petitt, G.A.; Young, K.G.; Sarantites, D.G.; Maguire, C.F. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Physical Review Letters (U.S.);* **46**: No. 1, 8-11(5 Jan 1981).

Spectra and angular distributions of neutrons in coincidence with light fragments produced in deeply inelastic collisions of ^{16}O on ^{93}Nb at 204 MeV have been measured. A significant number of neutrons are emitted in the forward direction with beamlike velocities. We were not able to fit the detailed spectra and angular distributions assuming evaporation from accelerated fragments. This presents first direct evidence for nonequilibrium neutron emission in deeply inelastic reactions.

6518 Nuclear Properties And Reactions,a=150-189

REFER ALSO TO CITATION(S) 9939

9925 Magnetic electron scattering from ^{181}Ta. Rad, F.N.; Bertozzi, W.; Kowalski, S.; Sargent, C.P.; Williamson, C.F.; Hynes, M.V.; Norum, B.; Peterson, B.; Sasanuma, T.; Turchinetz, W. (Department of Physics, Laboratory for Nuclear Science, and Bates Linear Accelerator Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). DE-AC02-76ER0-3069. *Physical Review Letters (U.S.);* **45**: No. 22, 1758-1761(1 Dec 1980).

Transverse electron scattering form factors from the ground-state rotational band of ^{181}Ta have been measured to study the single-particle contribution to the magnetization current density. The data are compared with a Hartree-Fock calculation by use of density matrix expansion with filling approximation.

9926 Detailed test of the interacting boson approximation in a well-deformed nucleus: The positive-parity states of ^{168}Er. Warner, D.D.; Casten, R.F.; Davidson, W.F. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). DE-AC02-76CH00016. *Physical Review Letters (U.S.);* **45**: No. 22, 1761-1765(1 Dec 1980).

The interacting boson approximation has been applied to the deformed nucleus ^{168}Er. The parametrization used corresponds to a

description close to the SU(3) limit of the model. The calculation, which is the most detailed twst of the interacting boson approximation to date, correctly reproduces the complete sequence of positive-parity collective bands below the pairing gap and provides an excellent everall description of their decay properties.

6519 Nuclear Properties And Reactions, A=190-219

9927 (LA—8303-C, pp 13-25) **Electron scattering from Pb.** Heisenberg, J. (Univ. of New Hampshire, Durham). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

It is shown how the electron scattering results are very closely related to the underlying nuclear structure and to the residual interaction. First, the low-lying negative-parity states in ^{208}Pb are discussed. Then, the identification of the high-spin states is considered, and finally some consequences for the nuclear interaction are examined. 10 figures, 2 tables. (RWR)

9928 (LA—8303-C, pp 331-335) **Observation of the double isobaric analog state in the reaction ^{209}Bi(π^+,π^-)^{209}At.** Braithwaite, W.J. (Univ. of Texas, Austin); Greene, S.J.; Moore, I.B.; Cottingame, W.B.; Holtkamp, D.B.; Moore, C.F.; Morris, C.L.; Thiessen, H.A.; Burleson, G.R.; Blanpied, G.S. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Double Charge Exchange (DCX) has been used to populate the Double Isobaric Analog State (DIAS) by using the neutron-rich target ^{209}Bi. An incident pion energy of 292 MeV was used because the DCX reaction mechanism has been shown to be dominated at this energy by the DIAS transition in previous work with the light target nuclei ^{16,18}O and ^{24,26}Mg. 2 figures.

9929 **(LA-UR—80-3475) Two-neutron transfer in Pt and Os nuclei and the IBA.** Cizewski, J.A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-8006127—3). NTIS, PC A02/MF A01.

From International conference on interacting bose-fermi systems in nuclei; Erice, Sicily, Italy (12 Jun 1980).

Two-neutron transfer studies in Pt and Os were investigated. The extracted relative enhancement factors in Pt were found to be in excellent agreement with the 0(6) limit predictions. The differences in transfer strength between Pt and Os (t,p) could not be reproduced within the present framework of the Interacting Boson Approximation Model. 3 figures.

9930 **(LA-UR—80-3476) Tests of dynamical supersymmetries via charged particle transfer reactions.** Cizewski, J.A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-8006127—4). NTIS, PC A02/MF A01.

From International conference on interacting bose-fermi systems in nuclei; Erice, Sicily, Italy (12 Jun 1980).

The (t,p) and (t/sup $\rightarrow$/,α) reactions on enriched ^{191,193}Ir targets were investigated. The resultant spectroscopic strengths are compared and contrasted with the expectations of the dynamical supersymmetry scheme proposed for the Pt-Ir region. 1 figure, 2 tables.

9931 **Structure in ^{200}Tl and the odd-even staggering in pi-tildeh/sub 9/2/xnu-tildei/sub 13/2/ bands.** Kreiner, A.J.; Mariscotti, M.A.J.; Baktash, C.; der Mateosian, E.; Thieberger, P. (Departamento de Fisica, Comision Nacional de Energia Atomica, Buenos Aires 1429, Argentina). *Physical Review, The. C. Nuclear Physics (U. S.);* **23**: No. 2, 748-754(Feb 1981).

States of ^{200}Tl, populated through the ^{198}Pt(^{6}Li,4n) reaction at E=30 to 40 MeV, were studied using in-beam γ-ray spectroscopy techniques. An almost completely new level scheme is presented comprising the pi-tildeh/sub 9/2/xnu-tildei/sub 13/2/ two-quasiparticle band which in this case is built on an I/sup π/=7$^-$ isomeric state (T/sub 1/2/=4.8 +- 0.2 ns) in contrast to I/sup π/=8$^-$ for all the lighter doubly odd Tl isotopes studied up to now. The systematic variation of the odd-even staggering present in these bands offers arguments to support the interpretation that this phenomenon is related to the signature dependence of the Coriolis interaction.

9932 **Nuclear-structure effects connected with charge-exchange resonances.** Krewald, S.; Osterfeld, F.; Speth, J.; Brown, G.E. (Institut fuer Kernphysik, Kernforschungsanlage Juelich, D-5170 Juelich, West Germany). EY-76-02-3001. *Physical Review Letters (U.S.);* **46**: No. 2, 103-106(12 Jan 1981).

The excitation energies and the (p,n) cross sections of the giant Gamow-Teller resonance as well as the isobaric analog state in ^{208}Pb are calculated. Similar to the results in electron scattering the theoretical spin-flip strength overestimates the experimental one appreciably. The excitation energies of the spin-dependent excitations and the isobaric analog resonance can only be explained simultaneously if the effects of the "dynamical theory of collective states" and of the one-pion— and one-rho—exchange potential are taken into account.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 9877, 9893

9933 (LA—8303-C, pp 72-81) **Comparison of shell model calculations with recent electron and pion scattering results.** Dubach, J.F. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

The present technology for large-scale shell model calculations is described. Examples are given to demonstrate the relevancy of such calculations for understanding current inelastic electron and pion scattering experiments. 7 figures.

9934 (LA—8303-C, pp 82-89) **Nuclear momentum distributions from (e,e'p) and (γ,p) reactions.** Matthews, J.L. (Massachusetts Inst. of Technology, Cambridge). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

The determination of nuclear momentum distributions from experimental studies of single-nucleon knock-out reactions is discussed, with specific reference to the (e,e'p) and (γ,p) processes. 4 figures.

9935 (LA—8303-C, pp 166-175) **Matter distributions compared with electron scattering results.** Gogny, D. (Service de Physique Neutronique et Nucleaire, France). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

In the framework of the self-consistent approach, an overview is given of a series of results characterizing the nuclear structure of some selected spherical nuclei - charge and neutron radii, charge difference between lead isotopes, valence orbital in ^{87}Sr and ^{93}Nb. Finally, the effect of long range correlations on the mass distribution of ^{40}Ca, ^{48}Ca, and ^{208}Pb is emphasized. 5 figures, 4 tables.

9936 (LA—8303-C, pp 249-251) **Projection operator treatment of the (π,p) reaction.** Kisslinger, L.S. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

The projection operator method, which leads to the isobar-doorway model, can provide a unified treatment of the (π,p) reaction. It allows extraction of the one-nucleon and two-nucleon mechanisms in a manner that eliminates double counting. Forms that should give a convenient method for this unified treatment are presented. (RWR)

9937 (LA—8303-C, pp 263-270) **Calculation of nuclear collective excitations from elastic scattering data.** Amado, R.D. (Univ. of Pennsylvania, Philadelphia); Lenz, F.; McNeil, J.A.; Sparrow, D.A. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Formulas are derived that give inelastic hadron-nucleus cross sections in terms of the elastic cross section and electromag-

netic width. These formulas rely only on the assumption of an impact parameter representation of the distortion, a transition density of Tassie form, and a closed form expression for the elastic amplitude derived previously. The formulas are used to compute the 3^- and 5^- inelastic excitations in Pb from the elastic data, and to relate the 2^+, 4^+, and 3^- excitations in Fe. The agreement with experiment is remarkable. The simplicity of these results should make them very useful. 2 figures.

9938 (LA—8303-C, pp 271-277) **Pion scattering with the MSU optical potential.** Carr, J.A. (Michigan State Univ., East Lansing). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Some results are presented with the MSU optical potential used for pion scattering. These include new pionic atom parameters for low-energy scattering, effect of absorption parameters on back-angle cross sections, consistency of βR values for pions and protons, and explaining differences between π^+ and π^- scattering. 9 figures, 3 tables.

9939 (LA—8303-C, pp 306-310) **Test of the interacting boson approximation using electron scattering.** Hersman, F.W.; Bertozzi, W.; Deady, M. (Massachusetts Inst. of Technology, Cambridge). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

A method has been devised for interpreting electron scattering data from three 2+ levels in ^{154}Gd to test the assumptions of the interacting boson approximation. The plane wave form factor is shown to be the relevant quantity in the test. The Hartree-Fock charge distribution is used as an example of the analysis technique. Experimental work is in progress at the MIT-Bates Laboratory. 4 figures.

9940 (LA—8303-C, pp 352-365) **Quark effects in nuclei.** Robson, D. Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

The effects of quarks in nuclei are investigated by use of a recently obtained interquark potential that fits a large range of meson data. Van der Waal interactions between hadrons are found to be nonexistent, and the nucleon-nucleon interaction is shown to take the form of a nonlocal spin-dependent potential. Hidden color components of the lightest nuclei are estimated to be 50% of the total wave function. This and other predictions for $A \leqq 4$ nuclei are briefly discussed. 2 figures, 2 tables.

9941 (LA—8303-C, pp 366-381) **Pion condensation.** Wiringa, R.B. (Los Alamos Scientific Lab., NM). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

The phenomenon of pion condensation is briefly reviewed. Various ways by which pion condensation effects may be observed are discussed, with emphasis on experiments with finite nuclei. 8 figures.

9942 (LA—8303-C, pp 382-387) **Conference summary.** Stephenson, G.J. Jr. (Los Alamos Scientific Lab., NM). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

The status of various aspects of nuclear structure as exemplified by workshop presentations is summarized. (RWR)

9943 (LA—8303-C, pp 402-410) **Application of a unified theory of elastic and rearrangement scattering to ^{4}He(p,d)^{3}He.** Greben, J.M. (TRIUMF, Vancouver, Canada). Apr 1980.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

A new theory of elastic and rearrangement scattering is briefly described. The application of this theory to ^{4}He(p,d)^{3}He is discussed. The transfer process is described by two diagrams, one of which dominates at backward angles. At forward angles, the rescattering diagram gives an important contribution at intermediate energies. 4 figures.

9944 **(LA-UR—80-3658) Perturbation theory approach to the ground state energy in an infinite Fermion system.** Baker, G.A. Jr. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 7p. (CONF-810107—1). NTIS, PC A02/MF A01.

From 2. international conference on recent progress in many-body theories; Mexico City, Mexico (12 Jan 1981).

The progress of the Rayleigh-Schroedinger perturbation theory approach to the computations of the ground-state energy in an infinite Fermion system is reviewed.

6540 Radiation And Shielding Physics

9945 **(ORNL/RSIC—44) Review of the theory and applications of Monte Carlo methods. Proceedings of a seminar-workshop, Oak Ridge, Tennessee, April 21-23, 1980.** Trubey, D.K.; McGill, B.L. (eds.). (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 349p. (CONF-800471—). NTIS, PC A15/MF A01.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

This report consists of 24 papers which were presented at the seminar on Theory and Application of Monte Carlo Methods, held in Oak Ridge on April 21-23, plus a summary of the three-man panel discussion which concluded the seminar and two papers which were not given orally. These papers constitute a current statement of the state of the art of the theory and application of Monte Carlo methods for radiation transport problems in shielding and reactor physics.

9946 (ORNL/RSIC—44, pp 47-62) **Monte Carlo perturbation theory in neutron transport calculations.** Hall, M.C.G. (Imperial Coll. of Science and Technology, London, England). Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

The need to obtain sensitivities in complicated geometrical configurations has resulted in the development of Monte Carlo sensitivity estimation. A new method has been developed to calculate energy-dependent sensitivities of any number of responses in a single Monte Carlo calculation with a very small time penalty. This estimation typically increases the tracking time per source particle by about 30%. The method of estimation is explained. Sensitivities obtained are compared with those calculated by discrete ordinates methods. Further theoretical developments, such as second-order perturbation theory and application to k/sub eff/ calculations, are discussed. The application of the method to uncertainty analysis and to the analysis of benchmark experiments is illustrated. 5 figures.

9947 (ORNL/RSIC—44, pp 63-93) **Studies of perturbations using correlated Monte Carlo method.** Dejonghe, G.; Gonnord, J.; Nimal, J.C. (CEA, Sacley, France). Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

The influence of light perturbations of cross sections on a set of neutronic responses cannot be estimated with an acceptable precision by statistically independent Monte Carlo calculations. Differential TRIPOLI, a tridimensional, polykinetic Monte Carlo code permits one to calculate such variations by correcting the weights of particles previously simulated by a standard TRIPOLI calculation for the nonperturbed problem. The same sample of neutrons is treated, so that a correlation factor appears that improves the variance on the differential results. 9 figures, 7 tables.

9948 (ORNL/RSIC—44, pp 121-128) **KENO V: the newest KENO Monte Carlo criticality program.** Landers, N.F.; Petrie, L.M. (Oak Ridge National Lab., TN). Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

KENO V is a new multigroup Monte Carlo criticality program developed in the tradition of KENO and KENO IV for use in the SCALE system. The primary purpose of KENO V is to determine k-effective. Other calculated quantities include lifetime and generation time, energy-dependent leakages, energy- and region-de-

pendent absorptions, fissions, fluxes, and fission densities. KENO V combines many of the efficient performance capabilities of KENO IV with improvements such as flexible data input, the ability to specify origins for cylindrical and spherical geometry regions, the capability of super grouping energy-dependent data, a P/sub n/ scattering model in the cross sections, a procedure for matching lethargy boundaries between albedos and cross sections to extend the usefulness of the albedo feature, and improved restart capabilities. This advanced user-oriented program combines simplified data input and efficient computer storage allocation to readily solve large problems whose computer storage requirements precluded solution when using KENO IV. 2 figures, 1 table.

9949 (ORNL/RSIC—44, pp 169-187) **Recursive Monte Carlo method for deep-penetration problems.** Goldstein, M. (Oak Ridge National Lab.); Greenspan, E. Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

The Recursive Monte Carlo (RMC) method developed for estimating importance function distributions in deep-penetration problems is described. Unique features of the method, including the ability to infer the importance function distribution pertaining to many detectors from, essentially, a single M.C. run and the ability to use the history tape created for a representative region to calculate the importance function in identical regions, are illustrated. The RMC method is applied to the solution of two realistic deep-penetration problems - a concrete shield problem and a Tokamak major penetration problem. It is found that the RMC method can provide the importance function distributions, required for importance sampling, with accuracy that is suitable for an efficient solution of the deep-penetration problems considered. The use of the RMC method improved, by one to three orders of magnitude, the solution efficiency of the two deep-penetration problems considered: a concrete shield problem and a Tokamak major penetration problem. 8 figures, 4 tables.

9950 (ORNL/RSIC—44, pp 219-229) **Calculational problem for deep penetration of neutrons through a one-bend sodium duct.** Sartori, E. (Nuclear Energy Agency Data Bank, Saclay, France). Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

This problem features a two-dimensional geometry representing a sodium duct surrounded by concrete that can easily be modeled with both Monte Carlo and two-dimensional S/sub N/ codes. The neutron source is placed on an external duct surface, has a uniform spectrum over the energy range of 5 to 2 MeV, and is forward peaked with a cosine distribution. The average distance covered by a neutron leaving the duct surface at the exit is about 360 cm. The importance sampling method of the Monte Carlo code TRIPOLI-2 is used. Fluxes and detector responses are tabulated for several surfaces defined along the neutron path in the sodium. A population of approximately 5000 neutrons undergoes about one million collisions giving flux and current at the duct exit with a standard error of 7.5%. 3 figures, 6 tables.

9951 (ORNL/RSIC—44, pp 295-304) **Experience with TRIPOLI at ORNL.** Cramer, S.N.; Roussin, R.W. (Oak Ridge National Lab., TN). Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

Initial use of the TRIPOLI code at Oak Ridge National Laboratory (ORNL) involves calculation of sample problems for both neutrons and gamma rays. Comparison with existing MORSE results indicates that the computing efficiency of TRIPOLI is somewhat better for the problems studied. Calculation of a thick (90 cm) concrete and steel integral experiment with TRIPOLI gives good agreement with the experimental results. This calculation involved the neutron count rate and unfolded energy spectra as measured in an NE213 detector behind the sample. It was necessary to expand the standard TRIPOLI cross section energy structure near the 2.3 MeV minimum in the total cross section of oxygen (a major constituent of concrete) to calculate the count rate near this energy correctly. A drawback of the TRIPOLI code is the lack of an automated method of performing coupled neutron and gamma-ray production calculations. 14 figures, 1 table.

9952 (ORNL/RSIC—44, pp 313-328) **Overview of TRIPOLI 2.** Baur, A.; Bourdet, L.; Dejonghe, G.; Gonnord, J.; Monnier, A.; Nimal, J.C.; Vergnaud, T. (CEA, Saclay, France). Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

The tridimensional Monte Carlo code TRIPOLI 2, which solves transport problems for neutrons or gamma rays, is presented. This code is used either for shielding calculations with deep penetration or for core calculations with fixed sources or for critical or subcritical problems. The principal block diagram of the system is given. The geometry characteristics, cross section utilization, weighting, source distribution, and results obtained by the code are described. 5 figures.

9953 (ORNL/RSIC—44, pp 329-344) **Variance reduction techniques using adjoint Monte Carlo method and Monte Carlo-Monte Carlo coupling in deep penetration problem.** Ueki, K. (Ship Research Inst., Tokyo, Japan). Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

The event value Wg (r, Ω) has been derived in a form that can be obtained directly from existing adjoint Monte Carlo computer codes. It is demonstrated that the event value and the point value functions obtained from the adjoint Monte Carlo can be used as the path-length biasing and the angular biasing in the forward Monte Carlo calculation, respectively. The iterative forward-adjoint Monte Carlo method using the source biasing is employed to reduce the standard deviation. In addition, the Monte Carlo-Monte Carlo coupling technique is investigated to calculate effectively neutron streaming through the two-legged duct. Significant improvements are obtained on the collision density and on the efficiency in the duct problem. 3 figures, 2 tables.

9954 **(SAND—80-1446) Collocation method for the solution of the neutron transport equation with both symmetric and asymmetric scattering.** Morel, J.E. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 185p. NTIS, PC A09/MF A01.

A collocation method is developed for the solution of the one-dimensional neutron transport equation in slab geometry with both symmetric and polarly asymmetric scattering. For the symmetric scattering case, it is found that the collocation method offers a combination of some of the best characteristics of the finite-element and discrete-ordinates methods. For the asymmetric scattering case, it is found that the computational cost of cross-section data processing under the collocation approach can be significantly less than that associated with the discrete-ordinates approach. A general diffusion equation treating both symmetric and asymmetric scattering is developed and used in a synthetic acceleration algorithm to accelerate the iterative convergence of collocation solutions. It is shown that a certain type of asymmetric scattering can radically alter the asymptotic behavior of the transport solution and is mathematically equivalent within the diffusion approximation to particle transport under the influence of an electric field. The method is easily extended to other geometries and higher dimensions. Applications exist in the areas of neutron transport with highly anisotropic scattering (such as that associated with hydrogenous media), charged-particle transport, and particle transport in controlled-fusion plasmas. 23 figures, 6 tables.

9955 **(SAND—80-2720) Tables of Lobatto quadrature sets for S/sub N/ calculations in one-dimensional cylindrical geometry.** Morel, J.E. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 20p. NTIS, PC A02/MF A01.

Tables of Lobatto quadrature sets for S/sub N/ calculations in one-dimensional cylindrical geometry are presented. The order of the sets varies from S_2 to S_{10}. Each S/sub N/ set is sufficiently accurate to be used in conjunction with Legendre cross-section expansions of degree N-1. These sets are particularly useful for calculations with normally incident sources and line sources and for adjoint calculations with plane-incident forward sources. 3 figures, 1 table.

9956 (SAND—80-2860C) Ion channeling analysis of disorder. Picraux, S.T. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 30p. (CONF-801124—39). NTIS, PC A03/MF A01.

From 3. annual meeting of the Materials Research Society; Boston, MA, USA (17 Nov 1980).

The use of ion channeling to characterize disorder in semiconductors is briefly reviewed. At high defect densities the ion channeling/backscattering technique can give the depth distribution of defects with a resolution ~ 10 nm. Quantitative analysis of the defect depth profile requires that a single type of defect dominates the scattering of particles out of channeling trajectories. This scattering process is characterized by two defect-specific quantities: the direct scattering factor and the dechanneling cross-section. For impurity-associated defects the lattice location of the impurity atoms can be determined to within ~ 0.1 A by simultaneously measuring the impurity and host atom signals as a function of tilt angle about channeling directions. The channeling technique can detect a wide range of intrinsic defects including interstitials, dislocations, stacking faults, microtwins, and amorphous clusters. Examples of the application of channeling to study defects in silicon will be given for the cases: (1) hydrogen trapping at defects; (2) ion implantation doping; and (3) epitaxial growth of layers.

9957 (UCID—18858) Scoring methods for implicit Monte Carlo radiation transport. Edwards, A.L. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Jan 1981. Contract W-7405-ENG-48. 23p. NTIS, PC A02/MF A01.

Analytical and numerical tests were made of a number of possible methods for scoring the energy exchange between radiation and matter in the implicit Monte Carlo (IMC) radiation transport scheme of Fleck and Cummings. The interactions considered were effective absorption, elastic scattering, and Compton scattering. The scoring methods tested were limited to simple combinations of analogue, linear expected value, and exponential expected value scoring. Only two scoring methods were found that produced the same results as a pure analogue method. These are a combination of exponential expected value absorption and deposition and analogue Compton scattering of the particle, with either linear expected value Compton deposition or analogue Compton deposition. In both methods, the collision distance is based on the total scattering cross section.

6550 Medical Physics

REFER ALSO TO CITATION(S) 9712

9958 (AD-A—082639) US Army Test and Evaluation Command, test operations procedure, gamma ray source calibration. Final report. (Army Test and Evaluation Command, Aberdeen Proving Ground, MD (USA)). 28 Mar 1980. 9p. NTIS, PC A02/MF A01.

This TOP provides techniques to perform periodic calibration of gamma ray sources used as secondary standards. The personnel must be trained and experienced in Radiac calibration equipment and for that reason the procedures are not step-by-step but are planned to be interpreted by the operator in each instance.

9959 (ORNL/RSIC—44, pp 203-217) Adjoint Monte Carlo techniques and codes for organ dose calculations. Koblinger, L. (Central Research Inst. for Physics, Budapest, Hungary). Aug 1980.

From Seminar on theory and applications of Monte Carlo methods; Oak Ridge, TN, USA (Apr 1980).

Adjoint Monte Carlo simulations can be effectively used for the estimation of doses in small targets when the sources are extended in large volumes or surfaces. The main features of two computer codes for calculating doses at free points or in organs of an anthropomorphic phantom are described. In the first program (REBEL-3) natural gamma-emitting sources are contained in the walls of a dwelling room; in the second one (POKER-CAMP) the user can specify arbitrary gamma sources with different spatial distributions in the environment: in (or on the surface of) the ground and in the air. 3 figures.

6560 Solid State Physics

9960 (DOE/ER/10440—1) Determinations of lattice and electronic structures of solids by electron scattering. Progress report, July 1, 1979-June 30, 1980. Gibbons, P.C. (Washington Univ., St. Louis, MO (USA). Dept. of Physics). 1980. Contract AS02-79ER10440. 14p. NTIS, PC A02/MF A01.

The design and fabrication of all the major components of the system were completed. The electronics were assembled and tested. The spectrometer was assembled and tested, with first full operation of the facility before June 30, 1980. Techniques and facilities for sample preparation, sample characterization, data gathering, and data analysis are functional. Operation of the electron microscope and the electron detector, and ray-tracing analysis of the spectrometer, produced results sufficient to allow a refined estimate of the system's performance. It is believed to be quite reliable, and confirms earlier estimates. The continuing studies of plasmon damping are nearly finished. This report is descriptive in nature, with no data. (RWR)

9961 Have solitons been observed in $CsNiF_3$?. Reiter, G. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). DE-AC02-76CH00016. *Physical Review Letters (U.S.);* **46**: No. 3, 202-205(19 Jan 1981).

It is shown that a noninteracting—spin-wave theory, in which the central component observed by neutron scattering is attributed to scattering from spin-wave—density fluctuations, gives intensities comparable to, or greater than, the intensities predicted by the soliton theory, and provides a better fit to the variation of the intensity with field, temperature, and wave vector. We conclude that further work is needed to distinguish the soliton contribution to the central-peak intensity from the scattering by pairs of spin waves.

9962 High-pressure mechanical instability in close-packed Hooke's-law crystals. Ladd, A.J.C.; Hoover, W.G. (Department of Applied Science, University of California at Davis, Davis, California 95616). *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 1337-1339(15 Jan 1981).

Lattice dynamics and molecular dynamics are used to study close-packed crystals with pairwise-additive Hooke's-law interparticle potentials. Lattice dynamics describes a mechanical soft-mode instability at high pressure. In two dimensions molecular dynamics reveals that a thermodynamic transition, from the triangular close-packed lattice to the square lattice, occurs before the soft-mode instability density is reached. Similar phenomena occur in the three-dimensional close-packed lattices.

9963 Desorption from solid surfaces via generalized Slater theory. Adams, J.E.; Doll, J.D. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 1467-1471(15 Jan 1981).

The recently reported generalization of Slater's theory of unimolecular reactions has been applied to the problem of atomic desorption from a crystalline solid (specifically, helium from solid xenon). Using this formalism we are able to calculate the temperature and surface coverage dependence of the desorption rate constant as well as to observe the extent to which the rate is sensitive to the structure of the crystal substrate. In addition, our results suggest that a cooperative desorption mechanism may become important at low surface temperatures for some systems.

9964 Measurement of refractive indices and study of isotropic-nematic phase transition by the surface plasmon technique. Chu, K.C.; Chen, C.K.; Shen, Y.R. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Molecular Crystals and Liquid Crystals (formerly Molecular Crystals) (England);* **59**: 97-108(1980).

The surface plasmon technique is employed to measure the refractive indices and to probe the nematic-isotropic phase transition of 4-cyano-4'-n-pentylbiphenyl. Coexistence of isotropic and nematic phases in a 60 mK range and a hysteresis effect of the phase transition have been observed. A diffuse droplet model is used to estimate the supercooling and superheating range.

9965 **Validity of classical statistical mechanics for ferromagnetic Heisenberg chains with an easy plane.** Bishop, A.R. (Los Alamos Scientific Lab., NM). *Journal of Physics, C (London). Solid State Physics (Formerly Journal of Physics, C (London). Proceedings of the Physical Society (Solid State Physics)) (England);* **13**: L67-L72(1980).

Quantum corrections to the classical statistical mechanics of quasi-one-dimensional easy-plane ferromagnets (e.g., $CsNiF_3$) in the presence of an easy-plane magnetic field are outlined. Criteria for the validity of a classical description are suggested on the basis of complete quantisation of strongly non-linear excitations. One of these criteria agrees well with one suggested by H J Mikeska and E Patzak on the basis of a low-order quantum perturbation theory for essentially linear modes in the absence of a magnetic field. It is confirmed that $CsNiF_3$ can be treated substantially classically in typical experimental circumstances.

9966 **Correlation effects in hopping transport.** Pollak, M. (Univ. of California, Riverside); Knotek, M.L. *Journal of Non-Crystalline Solids (Netherlands);* **32**: 141-159(1979).

The effects of intersite Coulomb interactions on transport in a system of localized states is examined. Correlation effects are seen to inhibit the DC conduction but to enhance the ac conduction. It is shown that the interactions lead to a Coulomb gap in the one-electron excitation spectrum for DC conduction of width E/sub g/ proportional to E/sub c/ (E/sub c//W)/sup 1/2/, where E/sub c/ is the average intersite Coulomb energy and W is the random potential. The need to excite across the Coulomb gap can be alleviated by multi-electron hopping, which can lead to a non-activated T/sup -1/4/-like behavior as transport becomes collective in nature. Examples of systems where correlations effects have been observed are given. The possibility of a many-electron delocalization is also discussed.

6561 Superconductivity

REFER ALSO TO CITATION(S) 9415, 9416

9967 **Search for vortex unbinding in two-dimensional superconductors.** Bancel, P.A.; Gray, K.E. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters (U.S.);* **46**: No. 2, 148-152(12 Jan 1981).

The Kosterlitz-Thouless theory applied to two-dimensional superconducting films suggests that vortex unbinding can explain their gradual resistive transitions. An experiment which directly probes the dynamics of unbinding is reported. The results indicate that, if vortex unbinding is occurring in our superconducting films, the dynamic theory overestimates the relaxation time by almost two orders of magnitude.

6570 Theoretical Physics

9968 **(UCRL—53055) Finite amplitude extension of geometric acoustics in a moving, inhomogeneous atmosphere.** Warshaw, S.I. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Sep 1980. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01.

The theory of linear geometric acoustics as developed by Blokhintsev is extended to the nonlinear acoustic regime by applying the method of Riemann invariants to the propagation of acoustically small pulses along ray paths in a moving, inhomogeneous, thermoviscous medium. Blokhintsev's derivation is reviewed in detail, and is used to define an almost Galilean transformation of the nonlinear propagation equations from a quiescent to a moving medium. The nonlinear convective and dissipative processes are assumed to have a negligibly small effect on the ray paths. The differential equations of the ray paths and the propagation of the pulses are presented, and specialized to the example of a horizontally moving, gravitationally stratified atmosphere.

9969 **Computer simulation of a grand canonical ensemble of rodlike molecules.** Yoon, K.; Chae, D.G.; Ree, T.; Ree, F.H. (Department of Biology, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Journal of Chemical Physics, The (U.S.);* **74**: No. 2, 1412-1423(15 Jan 1981).

A Monte Carlo method for simulating a grand canonical ensemble of semi-infinite lattice—gas systems is proposed. This method evaluates the largest eigenvalue of the Kramers—Wannier matrix by means of Markov chains. The method is applied to two-dimensional lattice—gas systems of dimers, trimers, and tetramers (having the length-to-width ratios of two, three, and four, respectively) as well as to molecules with equal side lengths. No first-order isotropic-to-aligned phase change is found for the rodlike systems. The tetramer system, however, indicates a probable higher-order phase change.

9970 **Imaging a conserved scalar in gas mixing by means of a linear spark.** Schmieder, R.W.; Kerstein, A. (Sandia National Laboratories, Livermore, California 94550). *Applied Optics (U.S.);* **19**: No. 24, 4210-4213(15 Dec 1980).

A straight filamentary spark produced by a laser has been used to image the spatial distribution of gases in a jet of methane in air. The technique provides a direct map of a conserved scalar quantity useful in modeling turbulent reacting flows and may have other experimental advantages.

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9971 **(AD-A—083390) The 24 inch cusp experiment. Final report.** Pechacek, R.E.; Greig, J.R.; Raleigh, M.; Koopman, D.W.; DeSilva, A.W. (Naval Research Lab., Washington, DC (USA)). 15 Feb 1980. 61p. NTIS, PC A04/MF A01.

A spectroscopically pure, fully ionized D2 plasma containing 2 X 10 to the 19th power ions is generated from solid D2 pellets using a sequence of a 100 J Nd-Glass laser pulse and a 1000 J CO2 laser pulse. The plasma is used to fill a cusp configured magnetic field with a beta = 1 plasma. The width of the ring cusp is determined using laser scattering techniques. The laser scattering result, which agrees with chamber wall light emission and chemical deposits, is that the ring cusp is an ion Larmor radius wide, in contrast to recent experiments that have indicated that the cusp width is considerably narrower.

9972 **(COO—2218-195) Charged-particle cross section data for fusion plasma applications.** Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1980. Contract AS02-76ET52040. 35p. (CONF-800979—12). NTIS, PC A03/MF A01.

From Workshop on nuclear data evaluation methods and procedures; Upton, NY, USA (22 Sep 1980).

Cross-section data for fusion plasma calculations are reviewed for three categories: fusion reactions, nuclear elastic and inelastic scattering. While the data base for the basic D-T fuel cycle seems adequate for present purposes, continued refinement appears warranted. Further, increasing emphasis on advanced-fuel fusion introduces requirements for new reaction rate and charged-particle scattering data over a wider range of reacting species (light elements through ^{11}B) and over a larger energy range (to several MeV). These new needs are discussed along with suggestions for increased emphasis on providing the user with more convenient compilations. In particular, the extension of reactivities ($< \sigma V$) to non-Maxwellian distributions, scattering matrix data, and development of computer based files are noted.

9973 **(COO—2218-197) Confinement requirements for OHMIC-compressive ignition of a Spheromak plasma.** Olson, R.; Gilligan, J.; Miley, G. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1980. Contract AS02-76ET52040. 2p. (CONF-801215—9). NTIS, PC A02/MF A01.

From 3. symposium on the physics and technology of compact toroids in the magnetic fusion energy program; Los Alamos, NM, USA (2 Dec 1980).

The Moving Plasmoid Reactor (MPR) is an attractive alternative magnetic fusion scheme in which Spheromak plasmoids are envisioned to be formed, compressed, burned, and expanded as the

plasmoids translate through a series of linear reactor modules. Although auxiliary heating of the plasmoids may be possible, the MPR scenario would be especially interesting if ohmic decay and compression along were sufficient to heat the plasmoids to an ignition temperature. In the present work, we will study the transport conditions under which a Spheromak plasmoid could be expected to reach ignition via a combination of ohmic and compression heating.

9974 (COO—2218-198) Nuclear elastic scattering effects on fusion burns in compact tori. Galambos, J.; DeVeaux, J.; Greenspan, E.; Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1980. Contract AS02-76ET52040. 4p. (CONF-801215—10). NTIS, PC A02/MF A01.

From 3. symposium on the physics and technology of compact toroids in the magnetic fusion energy program; Los Alamos, NM, USA (2 Dec 1980).

This work reports on preliminary results from two independent, though related studies of NES effeNEWts on characteristics of advanced-fuel compact tori: (1) The effect of NES on the startup of a Field Reversed 0 pinch (FROP) Moving Plasmoid Reactor (MPR), which emphasizes the time-dependent effects of NES, and (2) Spatial effects of NES in Field Reversed Mirrors (FRM). In particular the effect of NES on fusion-product orbits and the fraction of their energy being deposited in the plasma.

9975 (DOE/DP/40116—1) Laser/plasma theory for microwave modeling experiments. Final report. Thomson, J.J.; Divergilio, W.F. (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). 1980. Contract AC08-79DP40116. 36p. NTIS, PC A03/MF A01.

During the last year, we have carried out theoretical investigations of microwave-plasma interactions in support of both the UCLA program, and the TRW program. The UCLA program concentrated on experimental studies of Stimulated Brillouin Scattering (SBS). We derived a theory which successfully explained the basic features of their experiment. The TRW program was originally conceived of as an investigation of electron heating and thermal transport; however, the subject was later changed to the interaction of SBS and self focusing. The experimental program has not yet started; however, we have developed a theoretical description of the expected interaction.

9976 (DOE/ET/51017—T1) Symmetric tandem mirror program. Annual progress report, period ending October 1980. (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). Oct 1980. Contract AC03-79ET51017. 61p. NTIS, PC A04/MF A01.

A technique for measuring the spatial distribution of the diamagnetism of the energetic electron plasma was developed. Using this technique, it was determined that high-β plasmas ($\beta \sim 50\%$) are indeed produced with their pressure peak near the second harmonic locations in the plane midway between the mirror coils. Measurements of the cold plasma properties (Te, n/sub e/) led to deeper understanding of the plasma equilibrium. It was found that the electron temperature is controlled by adjustment of the neutral density (10 , Te < 50 eV). The cold plasma density is determined by the applied power. It was found that the minimum ratio of cold to hot electron density for which stable equilibria exist is approximately unity (with an uncertainty of a factor of three remaining in the measurements).

9977 (DOE/ET/52002—T1) Massachusetts Institute of Technology, Plasma Fusion Center, Technical Research Programs. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Aug 1980. Contract AS02-76ET52002. 100p. NTIS, PC A05/MF A01.

A review is given of the technical programs carried out by the Plasma Fusion Center. The major divisions of work areas are applied plasma research, confinement experiments, fusion technology and engineering, and fusion systems. Some objectives and results of each program are described. (MOW)

9978 (DOE/ET/53051—17) q < 1 discharges in Tokapole II. Osborne, T.H.; Dexter, R.N.; Prager, S.C. (Wisconsin Univ., Madison (USA). Dept. of Physics). Jan 1981. Contract AS02-76ET53051. 17p. NTIS, PC A02/MF A01.

Observations are reported of discharges in which safety factor q values are obtained as low as 0.4 in Tokapole II, a tokamak with a four-node poloidal divertor configuration.

9979 (GA-A—16034) Titanium gettering in Doublet III. de Grassie, J.S.; Callis, R.; Campbell, G. (General Atomic Co., San Diego, CA (USA); Japan Atomic Energy Research Inst., Tokyo). Aug 1980. Contract AT03-76ET51011. 17p. (CONF-801037—37). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

The application of mild titanium gettering in the Doublet III tokamak has led to a significant improvement in the obtainable operating regimes and discharge parameters for all of the many plasma cross-sectional shapes studied. With gettering, low-Z impurities and radiated power are greatly reduced. The maximum line averaged electron density has increased 50% (anti n/sub e max/ ~ 1 x $10^{20}/m^3$), corresponding to a Murakami coefficient of nearly 6.

9980 (LA-UR—80-3409) Role of impurities in producing thermal instability in the RFP. Caramana, E.J.; Perkins, F.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800484—10). NTIS, PC A02/MF A01.

From Reversed field pinch theory workshop; Los Alamos, NM, USA (28 Apr 1980).

A physics model of the thermal instabilities is described. A physical explanation of these instabilities is given. (MOW)

9981 (LBL—10748) Study of ion line broadening in the Tormac discharge. Shaw, R.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract W-7405-ENG-48. 197p. NTIS, PC A09/MF A01.

Thesis.

Tormac (Toroidal Magnetic Cusp) is a magnetic confinement plasma concept having absolute minimum-B geometry. Two versions of Tormac are considered here. Tormac T IV-c has a glass vessel of rectangular cross section, 0.5 m in diameter. The confinement field rises to ~ 4.5 kG in ~ 8.3 μsec. Tormac T V has a T-shaped glass vessel, 1 m in diameter, with a field of ~ 3 kG, rising in ~ 10 μsec. Gaussian HeII 4686 A spectral lines having full widths at half maximum over 2 A have been observed in both Tormac plasmas.

9982 (MSNW—81-1158-1) Axial shock wave heating of reversed-field theta-pinch plasmas. Steinhauer, L.C. (Mathematical Sciences Northwest, Inc., Bellevue, WA (USA)). Nov 1980. Contract AC06-80ER53098. 52p. NTIS, PC A04/MF A01.

Reversed-field theta pinches are known to contract rapidly in the axial direction soon after the radial implosion. Under certain conditions the axial implosion can be quite strong. A model is described which simulates both the radial and axial implosions. Among the important features included are realistic plasma density profiles, and current-driven anomalous transport. Given input parameters such as initial fill pressure, bias magnetic field, coil size, applied voltage (or electric field) and compression magnetic field, the model predicts the final plasma temperature, density, radial and axial dimensions, trapped magnetic flux and fraction of particles trapped within the separatrix. The results indicate very strong axial shock heating for high bias field, which leads to temperatures up to several times that predicted for simple field-free plasmas. The model is applied to parameters charcteristic of two recent experiments, and several features of the calculated results are shown to be consistent with experimental observations. It is also applied to a fusion reactor scale plasma: as a result of strong axial shock heating, the model predicts that fusion ignition (e.g., a temperature of 8 keV) can be achieved without resort to large electric field or large magnetic compression.

9983 **(ORNL/CSD/TM—138) Recalling ISX shot data files from the off-line archive.** Stanton, J.S. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 22p. NTIS, PC A03/MF A01.

This document describes a set of computer programs designed to allow access to ISX shot data files stored on off-line disk packs. The programs accept user requests for data files and build a queue of end requests. When an operator is available to mount the necessary disk packs, the system copies the requested files to an on-line disk area. The program runs on the Fusion Energy Division's DECsystem-10 computer. The request queue is implemented under the System 1022 data base management system. The support programs are coded in MACRO-10 and FORTRAN-10.

9984 **(ORNL/TM—7499) LERFCM: a computer code for spatial reconstruction of volume emission from chord measurements in plasmas.** Navarro, A.P.; Pare, V.K.; Dunlap, J.L. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 61p. NTIS, PC A04/MF A01.

Local Emissivity Reconstruction from Chord Measurements (LERFCM) is a package of computer programs used to determine the two-dimensional spatial distribution of the emission intensity of radiation in a plasma from line integral data, which represents signals from arrays of collimated detectors looking through the plasma along different chords in a plane. The method requires data from only a few detector arrays and assumes that the emission distribution in the plane of observation has a smooth angular dependence that can be represented by a few low-order harmonics. The intended application is a reconstruction of plasma shape and MHD instabilities, using data from arrays of soft x-ray detectors on Impurity Study Experiment Tokamak.

9985 **(ORNL/TM—7530) Plasma fluctuation measurements in ELMO bumpy torus.** Komori, A. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 41p. NTIS, PC A03/MF A01.

Spatially resolved density fluctuation measurements in the dc frequency range up to 500 kHz have been conducted on the ELMO Bumpy Torus (EBT-I) plasma using photodetectors and Langmuir probes. Plasma currents produced by microwave-heated hot electron annuli were found to reduce fluctuations of toroidal plasma to low levels. The mechanism of stabilization has been studied in detail. Large amplitude fluctuations that accompany the hot electron annuli that destroy a stable plasma confinement were observed at low neutral pressure.

9986 **(ORNL/TM—7552) Approach to ignition of tokamak reactors.** Sigmar, D.J. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 51p. NTIS, PC A04/MF A01.

Recent transport modeling results for JET, INTOR, and ETF are reviewed and analyzed with respect to existing uncertainties in the underlying physics, the self-consistency of the very large numerical codes, and the margin for ignition. The codes show ignition to occur in ETF/INTOR-sized machines if empirical scaling can be extrapolated to ion temperatures (and beta values) much higher than those presently achieved, if there is no significant impurity accumulation over the first 7 s, and if the known ideal and resistive MHD instabilities remain controllable for the evolving plasma profiles during ignition startup.

9987 **(ORNL/TM—7574) Collective scattering of gyrotron radiation for T/sub i/ measurements on EBT.** Bighel, L.; White, T.L. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 39p. NTIS, PC A03/MF A01.

For T/sub i/ measurements in EBT, 90° Thomson scattering of 110-GHz, cw gyrotron radiation is proposed. Currently measured steady-state plasma parameters are: n/sub e/ = 1.5 x 10^{12} cm^{-3}, T/sub e/ = 500 eV, and T/sub i/ = 100 eV, with f/sub ce/ = 28 GHz. The measured plasma background at 100 GHz due to synchrotron emission from the relativistic electron rings is 10^3 times stronger than the expected scattered signal for an input power level to the plasma P/sub i/ = 10 kW. Therefore, gyrotron output modulation and synchronous detection are required. The collectively scattered spectra will be observed with a heterodyne detection system containing eight i.f. channels; each channel consists of a filter, a video detector, and a lock-in amplifier (which synchronously detects the modulated scattered signal). Scattering from low level suprathermal fluctuations and the applicability of the diagnostic to tokamaks are also considered.

9988 **(ORNL/TM—7611) Neoclassical current effects in neutral beam-heated tokamaks.** Hogan, J.T. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 78p. NTIS, PC A05/MF A01.

There is a long-standing prediction from neoclassical theory that strong contributions to the toroidal current should be driven by friction between trapped and passing particles when β/sub pol/ exceeds $\sqrt{R/a}$ in a tokamak. A number of neutral beam heating experiments can now produce such parameters, and it is of interest to calculate the behavior which should occur in this regime to determine the feasibility of using such a bootstrap current as a steady-state tokamak current source. Since gross manifestations are absent in a wide range of experiments on the Impurity Study Experiment (ISX-B), as reported earlier, the conclusion is that the neoclassical current, if present, can have a value no larger than 25% of its theoretically calculated value. Since the neoclassical particle (Ware) pinch is strongly related to the neoclassical current in the theory (Onsager reciprocity), the existence of the particle pinch is thus called into question.

9989 **(SAI—254-80-566-LJ) Generalized gyrokinetics.** Catto, P.J.; Tang, W.M.; Baldwin, D.E. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Oct 1980. Contract AC03-76ET53057. 21p. (PRI—14). NTIS, PC A02/MF A01.

By retaining the magnetic moment μ to higher order in the gyroradius over scale length expansion and employing a gyrokinetic change of variables, a full finite beta derivation of the gyrokinetic equation is presented within the eikonal ansatz for arbitrary magnetic fields and μ dependent unperturbed distribution functions.

9990 **(SAI—254-80-633-LJ) Finite-Larmor-radius stabilization of ballooning modes in an axisymmetric tandem mirror.** D'Ippolito, D.A.; Francis, G.L.; Myra, J.R.; Tang, W.M. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Nov 1980. Contract AC03-76ET53057. 15p. (PRI—18). NTIS, PC A02/MF A01.

The stability of an axisymmetric tandem mirror to ballooning modes is examined including the effect of finite ion gyroradius stabilization. The central cell of the tandem mirror is treated as a long-thin system with isotropic pressure, while the end plug is modeled by a stabilizing boundary condition. For the particular equilibrium considered, the finite-Larmor radius corrections to the ideal magnetohydrodynamic theory indicate a strong stabilizing effect on high-n ballooning modes even for quite modest values of gyroradius, k/sub perpendicular to/rho/sub i/ ~ a/L much less than 1. The dependence of β/sub c/ on k/sub perpendicular to/rho/sub i/ is computed, and possible physical mechanisms associated with this stabilizing influence are discussed.

9991 **(UCID—18879) Sausage mode stability boundaries: enumeration and verification.** Chambers, F.W. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 2 Dec 1980. Contract W-7405-ENG-48. 19p. NTIS, PC A02/MF A01.

An axially symmetric sausage mode instability has been observed using particle simulation codes to propagate beams with a high degree of current neutralization. In this report the stability boundaries in terms of the magnitude and location of the return current are delineated for beams with square, Gaussian, and Bennett radial current profiles using the theoretical analysis of others. For the case in which the return current is held fixed as the beam propagates, a detailed comparison is made between the theoretical predictions and the results of the RINGFAST single disk particle simulation code. Agreement between theory and code results is good although the code results do show a slightly larger than predicted unstable region.

9992 **(UCID—18905) Orbit averaged radial buildup code for tandem mirror geometry.** Campbell, M.; Futch, A.H. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 22 Jan 1981. Contract W-7405-ENG-48. 24p. NTIS, PC A02/MF A01.

The radial Fokker-Planck (RFP) model of A. Futch was modified to treat plasma buildup in the tandem mirror plug and center cell with a self-consistent model (TOARBUC). Two major changes have been made to the original version of this code. First, the center cell is treated as having separate electron and ion confining potentials with the ion potential having the opposite sign of that in a conventional mirror. Second, a two-electron-temperature treatment derived by R. Cohen was included in the present model to allow the plug and center cell to have different T/sub e/'s as observed in the experiment. The following sections explain these changes in greater detail.

9993 **(UCID—18918) IPCS user's manual.** McGoldrick, P.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Dec 1980. Contract W-7405-ENG-48. 232p. NTIS, PC A11/MF A01.

The Interprocess Communications System (IPCS) was written to provide a virtual machine upon which the Supervisory Control and Diagnostic System (SCDS) for the Mirror Fusion Test Facility (MFTF) could be built. The hardware upon which the IPCS runs consists of nine minicomputers sharing some common memory.

9994 **(UCRL—52568) Soft x-ray streak camera for laser fusion applications.** Stradling, G.L. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Apr 1981. Contract W-7405-ENG-48. 83p. NTIS, PC A05/MF A01.

Thesis.

This thesis reviews the development and significance of the soft x-ray streak camera (SXRSC) in the context of inertial confinement fusion energy development. A brief introduction of laser fusion and laser fusion diagnostics is presented. The need for a soft x-ray streak camera as a laser fusion diagnostic is shown. Basic x-ray streak camera characteristics, design, and operation are reviewed. The SXRSC design criteria, the requirement for a subkilovolt x-ray transmitting window, and the resulting camera design are explained. Theory and design of reflector-filter pair combinations for three subkilovolt channels centered at 220 eV, 460 eV, and 620 eV are also presented. Calibration experiments are explained and data showing a dynamic range of 1000 and a sweep speed of 134 psec/mm are presented. Sensitivity modifications to the soft x-ray streak camera for a high-power target shot are described. A preliminary investigation, using a stepped cathode, of the thickness dependence of the gold photocathode response is discussed. Data from a typical Argus laser gold-disk target experiment are shown.

9995 **(UCRL—53086) Alternating-direction implicit numerical solution of the time-dependent, three-dimensional, single fluid, resistive magnetohydrodynamic equations.** Finan, C.H. III. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Dec 1980. Contract W-7405-ENG-48. 247p. NTIS, PC A11/MF A01.

Thesis.

Resistive magnetohydrodynamics (MHD) is described by a set of eight coupled, nonlinear, three-dimensional, time-dependent, partial differential equations. A computer code, IMP (Implicit MHD Program), has been developed to solve these equations numerically by the method of finite differences on an Eulerian mesh. In this model, the equations are expressed in orthogonal curvilinear coordinates, making the code applicable to a variety of coordinate systems. The Douglas-Gunn algorithm for Alternating-Direction Implicit (ADI) temporal advancement is used to avoid the limitations in timestep size imposed by explicit methods. The equations are solved simultaneously to avoid syncronization errors.

9996 **(UWFDM—349) Tandem mirror sloshing-electron plugs.** Kesner, J. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering; Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Apr 1980. Contract AS02-78ET52048. 16p. NTIS, PC A02/MF A01.

By a proper usage of ECRH heating in minimum-B tandem mirror plugs thermal barriers can be created which thermally insulate hot plug electrons from both the central cell and the outside environment. This arrangement can be utilized in an axisymmetric, outboard anchor plug arrangement or a minimum-B plug. In the axisymmetric arrangement ICRF can serve as a pump for preventing ions from accumulating in the thermal barrier potential depression whereas in the minimum-B plug unconfined drift orbits should prevent such an accumulation.

9997 **Mode converter for electron cyclotron resonance heating of toroidal plasmas.** Motley, R.W.; Hsuan, H.; Glanz, J. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). DE-AC02-76-CH03073. *Review of Scientific Instruments, The (U.S.);* **52**: No. 2, 180-182(Feb 1981).

A method is proposed for improving the efficiency of cyclotron resonance heating of a toroidal plasma by ordinary mode radiation from the outside of the torus. Radiation not absorbed in the first pass is reflected from the inside of the torus by a corrugated surface which rotates the polarization by 90 °, so that a secondary source of extraordinary waves is created in the high field, accessible region of the plasma.

9998 **Vortex solitons of drift waves and anomalous diffusion.** Nozaki, K. (Department of Physics, University of California, Los Angeles, California 90024). *Physical Review Letters (U.S.);* **46**: No. 3, 184-187(19 Jan 1981).

It is shown that two-dimensional solitons, being vortices propagating at characteristic speeds, can be formed in a long-wavelength drift-wave turbulence. A random set of vortex solitons scatters plasma particles and leads to enhanced diffusion, whose coefficient can become as large as that due to conventive cells.

9999 **Quasistatic formation of the spheromak plasma configuration.** Yamada, M.; Furth, H.P.; Hsu, W.; Janos, A.; Jardin, S.; Okabayashi, M.; Sinnis, J.; Stix, T.H.; Yamazaki, K. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). DE-AC02-76-CH03073. *Physical Review Letters (U.S.);* **46**: No. 3, 188-191(19 Jan 1981).

A novel method for creating the spheromak configuration has been proposed and verified experimentally. The scheme is based on a transfer of poloidal and toroidal magnetic fluxes into a plasma from a "flux core." We present the first experimental verification of this quasistatic (tau/sub Alfve/n< <tau/sub form/<tau/sub diff/) formation scheme, which is suitable for future scaleup to fusion-reactor parameters.

10000 **Double layers without current.** Perkins, F.W.; Sun, Y.C. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). DE-AC02-76-CH03073. *Physical Review Letters (U.S.);* **46**: No. 2, 115-118(12 Jan 1981).

The steady-state solution of the nonlinear Vlasov-Poisson equations is reduced to a nonlinear eigenvalue problem for the case of double-layer (potential drop) boundary conditions. Solutions with no relative electron-ion drifts are found. The kinetic stability is discussed. Suggestions for creating these states in experiments and computer simulations are offered.

10001 **Current generation with low-frequency waves.** Fisch, N.J.; Karney, C.F.F. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). DE-AC02-CH03073. *Physics of Fluids, The (U.S.);* **24**: No. 1, 27-39(Jan 1981).

Various types of traveling waves may be injected into a tokamak to continuously sustain the toroidal current. Interest in this problem arises from the possibility of operating tokamak reactors in the steady state. The low-frequency waves most suitable for this task are identified in terms of the power cost for deployment in a reactor. Means of exciting these waves and tradeoffs with design criteria are discussed. A comparison is made with the alternative attractive regime of high-frequency waves. Conclusions are based, in part, on the numerical solution of the two-dimensional Fokker—Planck equation with an added quasi-linear term due to the waves.

10002 **Nonlinear magnetohydrodynamic stability.** Bauer, F.; Betancourt, O.; Garabedian, P. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). DE-AC02-76ER03077. *Physics of Fluids, The (U.S.);* **24**: No. 1, 48-54(Jan 1981).

Ways have been found to significantly upgrade the resolution of an equilibrium and stability code that is based on the variational principle of ideal magnetohydrodynamics. Nonlinear saturation of ballooning modes for tokamaks has been demonstrated using a revised version of the code. Second stability regions are calculated from the nonlinear dependence of δW on β. An l=2,3 torsatron is described that appears to have no ideal magnetohydrodynamic instabilities for β as high as 5%.

10003 **Nonlinear evolution of drift cyclotron modes.** Aamodt, R.E.; Cohen, B.I.; Lee, Y.C.; Liu, C.S.; Nicholson, D.R.; Rosenbluth, M.N. (Plasma Research Institute, Science Applications, Inc., Boulder, Colorado 80302). DE-AC03-79-ET-53057. *Physics of Fluids, The (U.S.);* **24**: No. 1, 55-65(Jan 1981).

The space-time evolution of the drift-cyclotron instability as influenced by the nonlinear shift in the ion-cyclotron frequency is studied analytically, numerically, and by computer simulation. The analysis is specialized to the case of a single coherent wave with frequency near both a cyclotron harmonic and the ion diamagnetic frequency. Such an analysis is motivated by observations of large-amplitude ion-cyclotron waves in the 2XIIB mirror experiment, which were highly monochromatic and often exhibited these frequency characteristics. A nonlinear dispersion relation describing saturation of the instability is derived by means of a self-consistent analytical solution of the Vlasov—Poisson equations to third order in the wave amplitude. Solitary wave and self-similar solutions are obtained that describe nonlinear wave propagation. Numerical solution of a nonlinear evolution equation and particle simulation confirm the analysis.

10004 **Effects of toroidal coupling on the stability of tearing modes.** Carreras, B.; Hicks, H.R.; Lee, D.K. (Institute for Advanced Study, Princeton, New Jersey 08540). W-7405-ENG-26;DE-AC02-76ET. *Physics of Fluids, The (U.S.);* **24**: No. 1, 66-77(Jan 1981).

The time evolution of tearing modes in toroidal geometry is studied in the low-β and large aspect ratio limit. An initial value three-dimensional computer code which numerically advances the reduced set of resistive magnetohydrodynamic equations is employed. Toroidicity has, in general, a destabilizing effect on tearing modes in this limit. A generalization of Δ' formalism can be used to study the linear regime. The results obtained in this way are in very good agreement with the results from the initial value code. The nonlinear phase of the evolution is also followed numerically. In the case of strong interaction of different helicities, a larger region of stochastic magnetic field lines results than in the cylindrical geometry case.

10005 **Neoclassical transport in helically symmetric plasmas.** Pytte, A.; Boozer, A.H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). DE-AC02-CH03073. *Physics of Fluids, The (U.S.);* **24**: No. 1, 88-92(Jan 1981).

The neoclassical rate of diffusion is calculated in such a way that the result is applicable to both helically symmetric and toroidally symmetric plasmas.

10006 **Relativistic theory of electron cyclotron resonance heating.** Bernstein, I.B.; Baxter, D.C. (Science Applications, Inc., La Jolla, California 92037, and Yale University, New Haven, Connecticut 06520). *Physics of Fluids, The (U.S.);* **24**: No. 1, 108-126(Jan 1981).

The formal theory of the interaction of mildly relativistic electrons with a cyclotron resonant applied electromagnetic field described by geometric optics is developed. The electron distribution function is written as the sum of a quasi-static part f_0 and a high frequency part f_1. A quasi-linear theory is employed to describe these. The resulting transport equation f_0 is written to lowest significant order jointly in the reciprocal of the gyration frequency and the bounce frequency. It includes a relativistic collision term and a drag term associated with synchrotron emission. The linearized equations for f_1 are solved, and an expression for the high-frequency current is derived.

10007 **Temporal evolution of lower-hybrid waves in the presence of ponderomotive density fluctuations.** Karney, C.F.F. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). DE-AC02-76-CH03073. *Physics of Fluids, The (U.S.);* **24**: No. 1, 127-137(Jan 1981).

The propagation of lower-hybrid waves in the presence of ponderomotive density fluctuations is considered. The problem is treated in two dimensions, and in order to be able to correctly impose the boundary conditions, the waves are allowed to evolve in time. The fields are described by iv/sub tau/-$\int$ v/sub xi/ dzeta+v/sub zetazeta/+ v ^{2}v=0, where v is proportional to the electric field, tau to time, and zeta and ξ measure distances across and along the lower-hybrid ray. The behavior of the waves is investigated numerically. If the amplitude of the waves is large enough, the spectrum of the waves broadens and their parallel wavelength becomes shorter. The assumptions made in the formulation preclude the application of these results to the lower-hybrid heating experiment on Alcator-A. Nevertheless, there are indications that the physics embodied in this problem are responsible for some of the results of that experiment.

10008 **Uniqueness and inversion of the ballooning representation.** Hazeltine, R.D.; Hitchcock, D.A.; Mahajan, S.M. (Fusion Research Center, The University of Texas at Austin, Austin, Texas 78712). DE-AC05-76ET-53036. *Physics of Fluids, The (U.S.);* **24**: No. 1, 180-181(Jan 1981).

Scale-separation arguments underlying the balloning representation are employed to demonstrate that its coefficients are uniquely determined by the original function, contrary to certain suggestions in the literature. An explicit formula for inverting the series is displayed.

10009 **EBT ring physics: meeting report.** Uckan, N.A. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Journal of Fusion Energy (U.S.);* **1**: No. 1, 49-58(Jan 1981).

The purposes of the workshop were (1) to evaluate the status of the current experimental and theoretical understanding of the hot electron ring properties, (2) to identify the dominant physical processes that influence ring formation and scaling and their optimal behavior, and (3) to determine critical areas for near-term research.

10010 **Comparison of calculations of fusion product losses from a tokamak.** Hively, L.M.; Miley, G.H. (Univ. of Illinois, Urbana). *Journal of Fusion Energy (U.S.);* **1**: No. 1, 103-105(Jan 1981).

A comparison is made of models for 3.5-MeV alpha particle loss to the first wall of an axisymmetric tokamak, including calculations of the loss fraction, wall loading profile, and sensitivity to machine parameters.

10011 **Hard-x-ray spectrum from a single-electron-temperature laser plasma model.** Colombant, D.; Manheimer, W. (Plasma Physics Division, Naval Research Laboratory, Washington, D.C. 20375). *Journal of Applied Physics (U.S.);* **51**: No. 12, 6120-6123(Dec 1980).

Comparisons between hard-x-ray experimental spectra and those obtained from a planar one-dimensional one-temperature fluid laser-produced plasma model show good agreement over several orders of magnitude in x-ray intensity and for Nd-laser irradiances varying between 2 x 10^{14} and 8 x 10^{15} W/cm^2. The key to this agreement is the careful modeling of electron-energy flux limitation by return-current-driven ion-acoustic turbulence. The hard-x-ray temperature agrees with a (Iλ^2)/sup 1/3/ scaling law.

10012 **Laser interactions with plasmas.** Lax, B. (Massachusetts Inst. of Tech., Cambridge). pp 100-101 of IEEE 1974 Region Six (western USA) conference on optoelectronics and laser technology. New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1974).

From Region 6 conference; Albuquerque, NM, USA (24 Apr 1974).

The availability of high power CO_2 lasers has permitted the investigation of laser interactions with plasmas in magnetic fields. A quantitative investigation of the breakdown of gases in a magnetic field by laser radiation has been made. The breakdown threshold has been reduced with increased magnetic field due to the reduction in diffusion losses transverse to the magnetic field. Magnetic field enhancement of the heating of a laser-produced plasma has also been predicted by theoretical calculations. Experimental measurements of electron temperature using the He II line-to-continuum ratio technique have qualitatively confirmed this prediction. In addition, experiments which demonstrate the existence of beam-trapping density profiles in the presence of a magnetic field have been performed.

10013 **Carbon dioxide laser interaction with magnetized plasmas.** Kristiansen, M.; Molen, G.M. (Texas Tech. Univ., Lubbock). pp 102-114 of IEEE 1974 Region Six (western USA) conference on optoelectronics and laser technology. New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1974).

From Region 6 conference; Albuquerque, NM, USA (24 Apr 1974).

Current experimental work on CO_2 laser interaction with magnetized plasmas is summarized. Special attention is given to laser beam guiding in plasma density minima, to plasma heating experiments, and to investigations of laser produced plasmas in strong magnetic fields. Recent experimental results on beam guiding and plasma heating, by the authors, are described in some detail. The directions of various planned experiments are outlined. 50 references.

7002 Fusion Power Plant Technology

10014 **(COO—2218-199) Overview of alternate-fuel fusion.** Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1980. Contract AS02-76ET52040. 17p. (CONF-801210—15). NTIS, PC A02/MF A01.

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

Alternate fuels (AFs) such as Cat-D, D-^{3}He and p-^{11}B offer the potential advantages of elimination of tritium breeding and reduced energy release in neutrons. An adequate energy balance appears exceedingly difficult to achieve with proton-based fuels such as p-^{11}B. Thus Cat-D, which can ignite at temperatures in the range of 30 to 40 keV, represents the logical near-term candidate. An attractive variation which adds flexibility would be to develop semi-catalyzed-D plants for synfuel production with simultaneous generation of ^{3}He for use in D-^{3}He satellite electrical power plants. These approaches and problems are discussed.

10015 **(DOE/ER—0046/3) Damage analysis and fundamental studies. Quarterly progress report, July-September 1980.** (Hanford Engineering Development Lab., Richland, WA (USA)). Nov 1980. Contract AC14-76FF02170. 211p. NTIS, PC A10/MF A01.

This report is organized along topical lines in parallel to a Program Plan of the same title so that activities and accomplishments may be followed readily, relative to that Program Plan. Thus, the work of a given laboratory may appear throughout the report. The Table of Contents is annotated for the convenience of the reader.

10016 **(DOE/ER—0093) Advanced fusion concepts: project summaries.** (Department of Energy, Washington, DC (USA). Office of Energy Research). Dec 1980. 110p. NTIS, PC A05/MF A01.

This report contains descriptions of the activities of all the projects supported by the Advanced Fusion Concepts Branch of the Office of Fusion Energy, US Department of Energy. These descriptions are project summaries of each of the individual projects, and contain the following: title, principle investigators, funding levels, purpose, approach, progress, plans, milestones, graduate students, graduates, other professional staff, and recent publications. Information is given for each of the following programs: (1) reverse-field pinch, (2) compact toroid, (3) alternate fuel/multipoles, (4) stellarator/torsatron, (5) linear magnetic fusion, (6) liners, and (7) Tormac. (MOW)

10017 **(EGG-FT—5281) Fusion technology development: first wall/blanket system and component testing in existing nuclear facilities.** Hsu, P.Y.S.; Bohn, T.S.; Deis, G.A.; Judd, J.L.; Longhurst, G.R.; Miller, L.G.; Millsap, D.A.; Scott, A.J.; Wessol, D.E. (EG and G Idaho, Inc., Idaho Falls (USA)). Dec 1980. Contract AC07-76ID01570. 196p. NTIS, PC A09/MF A01.

A novel concept to produce a reasonable simulation of a fusion first wall/blanket test environment employing an existing nuclear facility, the Engineering Test Reactor at the Idaho National Engineering Laboratory, is presented. Preliminary results show that an asymmetric, nuclear test environment with surface and volumetric heating rates similar to those expected in a fusion first wall/blanket or divertor chamber surface appears feasible. The proposed concept takes advantage of nuclear reactions within the annulus of an existing test space (15 cm in diameter and approximately 100 cm high) to provide an energy flux to the surface of a test module. The principal reaction considered involves ^{3}He in the annulus as follows: $n + {}^3He \rightarrow p + t + 0.75$ MeV. Bulk heating in the test module is accomplished by neutron thermalization, gamma heating, and absorption reactions involving ^{6}Li in the blanket breeding region. The concept can be extended to modified core configurations that will accommodate test modules of different sizes and types. It makes possible development testing of first wall/blanket systems and other fusion components on a scale and in ways not otherwise available until actual high-power fusion reactors are built.

10018 **(GA-A—16085) Targets for high power neutral beams.** Kim, J. (General Atomic Co., San Diego, CA (USA)). 1980. Contract AT03-76ET51011. 9p. (CONF-801111—38). NTIS, PC A02/MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

Stopping high-power, long-pulse beams is fast becoming an engineering challenge, particularly in neutral beam injectors for heating magnetically confined plasmas. A brief review of neutral beam target technology is presented along with heat transfer calculations for some selected target designs.

10019 **(KMSF-U—1003) Analysis of x-ray emission and tritium content from glass microshell inertial fusion targets.** Alexander, S.M.; Henderson, T.M. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1980. Contract AC08-78DP40030. 7p. (CONF-801037—32). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

The inertial fusion program requires knowledge of the amount of gas contained within Microshell targets. Beta particles from the decay of tritium in a DT-filled shell interact with the glass walls producing x rays. Measurement of the intensity of the emitted x-rays yields information on tritium content and indirectly on total gas pressure in the shell. The x-ray yield is influenced by fill pressure, shell wall thickness, shell composition, and shell diameter. Experimental results have been obtained relating effects of fill pressure as well as glass composition on x ray production. These results have been compared with the energy deposition and secondary radiation as predicted by Monte Carlo code calculations. X ray spectra have been obtained with a Si(Li) detector. A qualitative measure of glass composition is obtained from the spectra: Si, Na, Al, K, Ca lines are clearly visible when present.

10020 **(LA—7755-PR) Inertial fusion program. Progress report, July 1-December 31, 1978.** Perkins, R.B. (Los Alamos Scientific Lab., NM (USA)). Nov 1980. Contract W-7405-ENG-36. 135p. NTIS, PC A07/MF A01.

Progress at Los Alamos Scientific Laboratory (LASL) in the development of high-energy short-pulse CO_2 laser systems for fusion research is reported. Improvements to LASL's two-beam system, Gemini, are outlined and experimental results are discussed. Our eight-beam system, Helios, was fired successfully on target for the first time, and became the world's most powerful gas laser for laser fusion studies. Work on Antares, our 100- to 200-TW target

irradiation system, is summarized, indicating that design work and building construction are 70 and 48% complete, respectively. A baseline design for automatic centering of laser beams onto the various relay mirrors and the optical design of the Antares front end are discussed. The results of various fusion reactor studies are summarized, as well as investigations of synthetic-fuel production through application of fusion energy to hydrogen production by thermochemical water splitting. Studies on increased efficiency of energy extraction in CO_2 lasers and on lifetimes of cryogenic pellets in a reactor environment are summarized, as well as the results of studies on pellet injection, tracking, and beam synchronization.

10021 **(LA—8491) Antares prototype 300-kJ, 250-kA Marx generator. Final report.** Riepe, K.B.; Barrone, L.L.; Bickford, K.J.; Livermore, G.H. (Los Alamos Scientific Lab., NM (USA)). Jan 1981. Contract W-7405-ENG-36. 27p. NTIS, PC A03/MF A01.

A high-energy, low-inductance, low prefire rate, low trigger jitter, high-voltage, pulsed-power supply was needed to drive the gas discharge in the Antares laser power amplifier. This report describes the design and testing of a Marx generator that meets these requirements, the development and testing of a high-capacity spark gap, and the selection of suitable capacitors and resistors.

10022 **(LA-UR—80-3408) Startup of the RFP in a quasi-adiabatic mode.** Caramana, E.J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800484—11). NTIS, PC A02/MF A01.

From Reversed field pinch theory workshop; Los Alamos, NM, USA (28 Apr 1980).

The equations describing the purely adiabatic formation of the reversed-field pinch are solved. This method of formation in principle remedies the problem of flux consumption during the startup phase of this device.

10023 **(LA-UR—80-3494) Scaling laws for FRC formation and prediction of FRX-C parameters.** Siemon, R.E.; Bartsch, R.R. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-801215—11). NTIS, PC A02/MF A01.

From 3. symposium on the physics and technology of compact toroids in the magnetic fusion energy program; Los Alamos, NM, USA (2 Dec 1980).

A semi-emperical method has been developed to extrapolate the experimental results from FRX-B, a field-reversed theta pinch which generates an FRC (Field-Reversed Configuration - a compact toroid with no toroidal field), to the larger size FRX-C. Even though there are many uncertainties about details of the dynamic processes by which an FRC is formed, the scaling exercise has proven useful in identifying limitations in the original FRX-C design and the design has been modified to have a lower voltage and larger capacitance. The goal of FRX-C remains unchanged: to test the confinement scaning of an FRC in a larger device over a wider range of temperatures. Of particular interest is the testing of possible MHD stability limits as the ratio of plasma size to gyro radius increases.

10024 **(LA-UR—80-3703) Optimization of parasitic isolators in laser fusion systems.** Figueira, J.F.; Phipps, C.R. Jr. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-801201—5). NTIS, PC A02/MF A01.

From 3. international conference on lasers and applications; New Orleans, LA, USA (15 Dec 1980).

The results of model calculations for the optimization of the efficiency of high-gain amplifier systems stabilized by saturable absorbers are described. It is shown that the isolator performance can be characterized by a convenient figure of merit.

10025 **(LBL—11635) D^- production by charge transfer in metal vapors.** Schlachter, A.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 9p. (CONF-801068—17). NTIS, PC A02/MF A01.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

Fast D^- ions can be produced from D^+ by multiple charge-transfer collisions in a metal-vapor target. Experimental cross sections and thick-target D^- yields are presented and discussed. The high D^- yield experimentally observed from charge transfer in cesium vapor is consistent with recent low-energy cross-section calculations and measurements.

10026 **(LBL—11636) Transport of low energy positive and negative ion beam by permanent magnets.** Leung, K.N.; Ehlers, K.W.; Hooper, E.B. Jr. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 7p. (CONF-801068—21). NTIS, PC A02/MF A01.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

An experimental investigation of low-energy ion beam guiding by a surface magnetic field generated by samarium cobalt magnets has been performed. It was found that magnets arranged in a multi-ring cusp configuration produced the best beam transport efficiency, in agreement with calculation of the charged particle trajectories for this particular magnet arrangement. This geometry is predicted to yield no distortion in the phase space of the beam. The effect is proportional to charge squared, and is therefore independent of the sign of the charge of the particle being transported.

10027 **(LBL—11637) Characteristics of a self-extraction negative ion source.** Ehlers, K.W.; Leung, K.N. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 9p. (CONF-801068—18). NTIS, PC A02/MF A01.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

A multi-cusp, self-extraction, negative hydrogen ion source has been designed and constructed. Several diagnostic techniques have been applied to study the operating characteristics of this type of source. Negative H^- and D^- ions are produced on a negatively biased converter surface, and are self-extracted from the system. With the addition of cesium, the source has been operated at a neutral pressure of 1×10^{-3} Torr to generate a steady-state H^- ion current greater than 400 mA. The generation of impurity negative ions has been investigated, as have methods for reducing the presence of background electrons in the ion exit region. Plans for a larger, next-generation device will be discussed.

10028 **(LBL—11638) H^- ion formation from a surface conversion type ion source.** Leung, K.N.; Ehlers, K.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 9p. (CONF-801068—19). NTIS, PC A02/MF A01.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

Volume-produced H^- ions have been extracted from a multicusp ion source by using a standard extraction system. In addition, a molybdenum converter is installed in the source to generate surface-produced H^- ions. The H^- ion yield is measured by a mass spectrometer. Without cesium, the production of H^- ions by the surface process is very small compared with those generated by volume production. However, the presence of cesium can greatly enhance the surface production yield. The energy spectrum shows that the surface-generated H^- ions contain two distinct groups when cesium is added to the discharge. The energy of one group is essentially that of the sheath potential and appears to be produced by a desorption process. The second group of H^- ions have slightly higher energies and appear to be formed by a reflection process. Different types of converter materials have also been tested.

10029 **(LBL—11640) Plasma neutralizers for H^- or D^- beams.** Berkner, K.H.; Pyle, R.V.; Savas, S.E.; Stalder, K.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 8p. (CONF-801068—20). NTIS, PC A02/MF A01.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

Plasma neutralizers can produce higher conversion efficiencies than are obtainable with gas neutralizers for the production of high-energy neutral beams from negative hydrogen ions. Little attention has been paid to experimental neutralizer studies because of the more critical problems connected with the development of negative-ion sources. With the prospect of accelerating ampere dc beams from extrapolatable ion sources some time next year, we are re-examining plasma neutralizers. Some basic considerations, two introductory experiments, and a next-step experiment are described.

10030 **(LBL—11839) Progress in computer-assisted diagnosis and control of neutral beam lines.** Theil, E.; Elischer, V.; Fiddler, J.; Jacobs, N.J.D.; Jacobson, V.; Lawhorn, R.; Uber, D.; Wilner, D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1980. Contract W-7405-ENG-48. 13p. (CONF-800950—17). NTIS, PC A02/MF A01.

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

This paper discusses the principles that have guided the development of a computerized diagnostic and control system for both the Neutral Beam Systems Test Facility at Lawrence Berkeley Laboratory and the Doublet III neutral beams at the General Atomic Company. The emphasis is not on the particular details of the implementation, but on general considerations which have influenced the design criteria for the system. Foremost among these are the requirements of an appropriate human interface to the system, and effective use of a relational data base. Examples are used to illustrate how these principles are carried out in practice. A systems view of diagnostic programs is suggested in the light of our experience.

10031 **(NRL-MR—4453) Critical elements of high gain laser fusion.** Bodner, S.E. (Naval Research Lab., Washington, DC (USA)). 21 Jan 1981. Contract AI01-77DP40042. 48p. NTIS, PC A03/MF A01.

Progress toward high gain laser fusion can be measured by a set of five critical elements. They are (1) the laser-to-fuel coupling efficiency, (2) the cold fuel isentrope, (3) the implosion asymmetry, (4) the ablation pressure, and (5) the ignition concept.

10032 **(ORNL/CSD/TM—137) Data format translation routines.** Burris, R.D. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 42p. NTIS, PC A03/MF A01.

To enable the effective connection of several dissimilar computers into a network, modification of the data being passed from one computer to another may become necessary. This document describes a package of routines which permit the translation of data in PDP-8 formats to PDP-11 or DECsystem-10 formats or from PDP-11 format to DECsystem-10 format. Additional routines are described which permit the effective use of the translation routines in the environment of the Fusion Energy Division (FED) network and the Elmo Bumpy Torus (EBT) data base.

10033 **(PPL—1741) Penetration seals for TFTR shielding.** Hondorp, H.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Dec 1980. Contract AM02-76CH03073. 29p. NTIS, PC A03/MF A01.

The penetrations of the shielding provided for TFTR are required to be sealed to avoid radiation streaming. This report provides a discussion of the properties required for these penetration seals. Several alternate designs are discussed and evaluated and designs recommended for specific applications.

10034 **(SAND—80-2353) Pulsed reflex ion source studies.** Bickes, R.W. Jr.; O'Hagan, J.B. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 69p. NTIS, PC A04/MF A01.

Parametric studies of demountable versions of the pulsed ion source used in Controlatron and Zetatron neutron tubes were carried out. The goal of these experiments, a continuation of earlier work by Bacon and O'Hagan, was to investigate the deuteron beam intensity as a function of source geometry, electrode materials, operating conditions and pulse length. Geometric variations produced only modest changes in the ion beam intensity; the most sensitive parameter was the length of the secondary cathode. There is some evidence that the addition of oxygen either in the gas feed or using alumina on the cathode surfaces can increase the atomic ion fraction. The lowest reliable operating source pressure was approximately 1.33 Pa. The longest pulse length was about 1.2 ms. Difficulties in measuring the ion currents are discussed and suggestions for future experiments are briefly outlined.

10035 **(SAND—80-2545) One-dimensional space-charge neutralization of ion beams.** Poukey, J.W. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 42p. NTIS, PC A03/MF A01.

Particle simulation methods and analytic theory are used to study the equilibrium, stability, and nonlinear behavior of the one-dimensional longitudinal space-charge neutralization problem. For both co-moving and space-charge-limited electrons, the potentials and phase-space behavior are computed, and the code results are shown to agree with analytic equilibria and stability results. The effect of ion-beam risetime on the transverse neutralization problem is studied.

10036 **(UCID—18877) Parametric expressions of tritium flow rates and inventories in a target factory.** Sherohman, J.W. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 29 Dec 1980. Contract W-7405-ENG-48. 26p. NTIS, PC A03/MF A01.

Parametric expressions have been derived for tritium flow rates and inventories in a target factory. The expressions are based on a tritium system that interfaces with a generalized target production process. The relationship of flow rates and inventories to target production form a basis for parametric study to determine the amount of tritium involved in the target factory of an ICF power plant.

10037 **(UCRL—52955) Mirror fusion test facility magnet system. Final design report.** Henning, C.D.; Hodges, A.J.; VanSant, J.H.; Dalder, E.N.; Hinkle, R.E.; Horvath, J.A.; Scanlan, R.M.; Shimer, D.W.; Baldi, R.W.; Tatro, R.E. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 3 Sep 1980. Contract W-7405-ENG-48. 129p. NTIS, PC A07/MF A01.

Information is given on each of the following topics: (1) magnet description, (2) superconducting manufacture, (3) mechanical behavior of conductor winding, (4) coil winding, (5) thermal analysis, (6) cryogenic system, (7) power supply system, (8) structural analysis, (9) structural finite element analysis refinement, (10) structural case fault analysis, and (11) structural metallurgy. (MOW)

10038 **(UCRL—52957(Rev.1)) Introduction to Praxis.** Greenwood, J.R.; Evans, A. Jr.; Morgan, C.R.; Zarnstorff, M.C. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 3 Dec 1980. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01.

Praxis is the practice of the programming art, science, and skill. It is a high-order language designed for the efficient programming of control and systems applications. It is a comprehensive, strongly typed, block-structured language in the tradition of Pascal, with much of the power of the Mesa and Ada languages. It supports the development of systems composed of separately compiled modules, user-defined data types, exception handling, detailed control mechanisms, and encapsulated data and routines. Direct access to machine facilities, efficient bit manipulation, and interlocked critical regions are provided within Praxis.

10039 **(UCRL—82827) Diagnostic measurements related to laser driven inertial confinement fusion.** Campbell, D.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Sep 1979. Contract W-7405-ENG-48. 31p. (CONF-791110—3). NTIS, PC A03/MF A01.

From Measurement science conference; San Luis Obispo, CA, USA (30 Nov 1979).

Scientists at the Lawrence Livermore Laboratory have been conducting laser driven inertial confinement fusion experiments for over five years. The first proof of the thermonuclear burn came at the Janus target irradiation facility in the spring of 1975. Since that

time three succeedingly higher energy facilities have been constructed at Livermore, Cyclops, Argus and Shiva, where increased fusion efficiency has been demonstrated. A new facility, called Nova, is now in the construction phase and we are hopeful that scientific break even (energy released compared to incident laser energy on target) will be demonstrated here in early 1980's. Projected progress of the Livermore program is shown.

10040 **(UCRL—84380) Some recent efforts toward high density implosions.** McClellan, G.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Dec 1980. Contract W-7405-ENG-48. 51p. (CONF-7908139—1). NTIS, PC A04/MF A01.

From Gordon conference on laser interaction with matter; Tilton, NH, USA (13 Aug 1979).

Some recent Livermore efforts towards achieving high-density implosions are presented. The implosion dynamics necessary to compress DT fuel to 10 to 100 times liquid density are discussed. Methods of diagnosing the maximum DT density for a specific design are presented along with results to date. The dynamics of the double-shelled target with an exploding outer shell are described, and some preliminary experimental results are presented.

10041 **Visible harmonic emission as a way of measuring profile steepening.** Carman, R.L.; Forslund, D.W.; Kindel, J.M. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters (U.S.);* **46**: No. 1, 29-32(5 Jan 1981).

First observed visible harmonics of CO_2-laser-irradiated plane and microballoon targets are reported. For intensities $>5 \times 10^{14}$ W/cm^2, the harmonic production efficiency is constant over several visible harmonics with a cutoff at a high harmonic number. Two-dimensional particle simulations performed where there is a highly steepened density profile show a flat spectrum for high harmonics, with a cutoff at the harmonic where the upper density shelf is underdense. Harmonics thus offer a means of measuring the upper density shelf and its dynamics.

10042 **Effects of anisotropic ion-wave damping in stimulated Brillouin scattering.** Speziale, T.; Berger, R.L. (KMS Fusion, Inc., Ann Arbor, Michigan 48106). DE-AC08-78DP40030. *Physical Review Letters (U.S.);* **46**: No. 1, 33-35(5 Jan 1981).

The effects of anisotropic ion-wave damping in stimulated Brillouin scattering, including rescattering, are investigated. Anisotropy is shown to reduce substantially the limiting (infinite plasma) reflection even at modest levels of $\beta = \nu/\text{sub } + //\nu/\text{sub } -/$, the ratio of the ion-wave-damping rates.

10043 **Engineering test facility.** Steiner, D. (Oak Ridge National Lab., TN); Becraft, W.R.; Sager, P.H. Contract W-7405-ENG-26. *Journal of Fusion Energy (U.S.);* **1**: No. 1, 5-13(Jan 1981).

The vehicle by which the fusion program would move into the engineering testing phase of fusion power development is designated the Engineering Test Facility (ETF). The ETF would provide a test-bed for reactor components in the fusion environment. In order to initiate preliminary planning for the ETF decision, the Office of Fusion Energy established the ETF Design Center activity to prepare the design of the ETF. This paper described the design status of the ETF.

10044 **Review of pellet fueling.** Milora, S.L. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Journal of Fusion Energy (U.S.);* **1**: No. 1, 15-48(Jan 1981).

The injection of frozen pellets composed of the isotopes of hydrogen has become the leading candidate for refueling fusion power reactors based on the tokamak concept. To some extent, the relative merits of this technique will depend upon the distance that the cryogenic pellet will penetrate such a plasma, and the early exploratory research has addressed this problem on both theoretical and experimental fronts. The conclusion from the theoretical effort is that a protective blanket consisting of hydrogenic gas or cold plasma will envelope the pellet and partially shield the surface from the intense plasma heat flux. The blanket prolongs pellet lifetime, but penetration to the plasma center might require pellet injection velocities in excess of 10 km/s.

10045 **Fusion-supported decentralized nuclear energy system.** Jassby, D.L. (Princeton Univ., NJ). Contract EY-76-C-02-3073. *Journal of Fusion Energy (U.S.);* **1**: No. 1, 59-67(Jan 1981).

A decentralized nuclear energy system is proposed comprising mass-produced pressurized water reactors in the size range 10 to 300 MW (thermal), to be used for the production of process heat, space heat, and electricity in applications where petroleum and natural gas are presently used. Special attention is given to maximizing the refueling interval with no interim batch shuffling in order to minimize fuel transport, reactor downtime, and opportunity for fissile diversion. The smallest reactors could be deployed as nuclear batteries, kept in the equivalent of spent-fuel shipping casks and returned to nuclear fuel centers for refueling. These objectives demand a substantial fissile enrichment (7 to 15%). The preferred fissile fuel is U-233, which offers an order of magnitude savings in ore requirements (compared with U-235 fuel), and whose higher conversion ratio in thermal reactors serves to extend the period of useful reactivity and relieve demand on the fissile breeding plants (compared with Pu-239 fuel). Application of the neutral-beam-driven tokamak fusion-neutron source to a U-233 breeding pilot plant is examined. This scheme can be extended in part to a decentralized fusion energy system, wherein remotely located large fusion reactors supply excess tritium to a distributed system of relatively small nonbreeding D-T reactors.

10046 **Design study of a 120-keV, ^{3}He neutral beam injector.** Blum, A.S.; Barr, W.L.; Dexter, W.L.; Fink, J.H.; Moir, R.W.; Wilcox, T.P. (Lawrence Livermore Lab., CA). *Journal of Fusion Energy (U.S.);* **1**: No. 1, 69-86(Jan 1981).

A 120-keV, 2.3-MW, ^{3}He neutral beam injector for use on a D-^{3}He fusion reactor is described. The constraint that limits operating life when injecting He is its high sputtering rate. The sputtering is partly controlled by using an extra grid to prevent ion flow from the neutralizer duct to the electron suppressor grid, but a tradeoff between beam current and operating life is still required. Hollow grid wires functioning as mercury heat pipes cool the grid and enable steady state operation. Voltage holding and radiation effects on the acceleration grid structure are discussed. We also briefly describe the vacuum system and analyze use of a direct energy converter to recapture energy from unneutralized ions exiting the neutralizer. Of crucial importance to the technical feasibility of the ^{3}He-burning reactor are the injector efficiency and cost; these are 53% and $5.5 million, respectively, when power supplies are included.

10047 **Radiological aspects of fusion reactor safety: risk constraints in severe accidents.** Kazimi, M.S.; Sawdye, R.W. (Massachusetts Inst. of Tech., Cambridge). *Journal of Fusion Energy (U.S.);* **1**: No. 1, 87-101(Jan 1981).

A methodology is proposed for determination of the constraints on severe accidents in lithium cooled fusion reactors, based on the potential hazards associated with such accidents. The method utilizes a probabilistic approach to risk calculation. The most effective mechanism for activation product release is found to be volatilization of structure as a result of lithium fires. Several factors were found to influence the consequence of lithium fires, most notably the reactor structural material type and total volume. It is concluded that the consequences of estimated maximum possible release from a properly designed fusion reactor are substantially less than the maximum light water reactor accident consequences.

10048 **Nonrandom suprathermal electron emission in resonance absorption.** Kolodner, P.; Yablonovitch, E. (Gordon McKay Laboratory, Harvard University, Cambridge, Massachusetts 02138). *Physical Review Letters (U.S.);* **45**: No. 22, 1790-1794(1 Dec 1980).

Evidence is reported for a nonrandom process by which laser-produced plasmas emit suprathermal electrons. Emission is dominated by a 1 to 2 psec monoenergetic burst, during which the electron energy decreases rapidly. The suprathermal tail on the energy distribution is due to the integrated temporal variation of the electron energy, not to statistical processes. The hot-electron temperature thus produced is practically independent of laser pulse energy.

10049 Profile modification and hot-electron temperature from resonant absorption at modest intensity. Albritton, J.R.; Langdon, A.B. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). W-7405-ENG-48. *Physical Review Letters (U.S.);* **45**: No. 22, 1794-1797(1 Dec 1980).

Resonant absorptin is investigated in expanding plasmas. The momentum deposition associated with the ejection of hot electrons toward low density via wave breaking readily exceeds that of the incident laser radiation and results in significant modification of the density profile at critical density. New scaling of hot-electron temperature with laser and plasma parameters is presented.

10050 Determination of fuel density-radius product of inertial confinement fusion targets by neutron activation. Campbell, E.M.; Lane, S.M.; Pan, Y.L.; Larsen, J.T.; Wahl, R.J.; Price, R.H. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Journal of Applied Physics (U.S.);* **51**: No. 12, 6062-6064(Dec 1980).

The quality of the confinement and thermonuclear burn of inertial confinement fusion targets scales as the density-radius product rhoR of the fuel. Neutron activation of trace elements placed in the fuel can be used to directly measure rhoR. This concept and several candidate tracers, ^{14}N, ^{40}Ar, and ^{79}Br, are discussed.

10051 Study of the general plasma characteristics of a high power, multifilament ion source. Schoenberg, K.F. Berkeley, CA; Univ. of California (1979). 137p. University Microfilms Order No. 80-14,871.

Thesis (Ph. D.).

A general assessment of the steady state and time dependent plasma properties which characterize a high power multifilament ion source is presented. Steady state measurements, obtained via a pulsed electrostatic probe data acquisition system, in part conclude: (a) the source electron distribution function consists of a bulk component of thermalized electrons(kT/sub e/ ≃ 3 to 5 eV) comprising 90 to 97% of the total electron population, plus a non-thermal high energy tail which is a monotonically decreasing function of energy, and contains a small but experimentally significant electron population at energy values 10 to 15 eV above maximum cathode fall; (b) overall steady state source performance approximately follows low pressure discharge theory assuming spatially uniform ion production.

99 GENERAL AND MISCELLANEOUS

9901 Management

10052 (SAND—80-1654) Network analysis planning for project management: a primer. Becktell, M.J. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01.

This is a step-by-step description of a methodology for planning a project by using techniques of network analysis. The methods are compatible with most available computer planning programs. Simple work-shop problems and solutions are included.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 8645, 9168, 9451, 9827, 10032, 10038

10053 (AD-A—084988) Using the binary-collision cascade simulation code MARLOWE on the ASC. Memorandum report. Mueller, G.P. (Naval Research Lab., Washington, DC (USA)). 20 Mar 1980. 5p. NTIS, PC A02/MF A01.

The binary-collision cascade simulation code MARLOWE is used to study the effects of irradiations on crystalline materials. We modified the IBM version of MARLOWE to run on the Texas Instruments ASC at NRL. This report outlines the changes made in the code and details how NRL users can access the code.

10054 (ANL-AMD-TM—336) Guide to computing at ANL. Peavler, J. (ed.). (Argonne National Lab., IL (USA)). 1 Jun 1979. Contract W-31-109-ENG-38. 80p. NTIS, PC A05/MF A01.

This publication gives details about hardware, software, procedures, and services of the Central Computing Facility, as well as information about how to become an authorized user. Languages, compilers' libraries, and applications packages available are described. 17 tables. (RWR)

10055 (BNL—28175) Model for the computer-aided-design of local computer networks. Peskin, A.M.; Yuen, K. (Brookhaven National Lab., Upton, NY (USA)). Jul 1980. Contract AC02-76CH00016. 16p. (CONF-810202—1). NTIS, PC A02/MF A01.

From 5. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (3 Feb 1981).

In recognition of the undisputed trends toward distributed-processing, resource-sharing local computer networks, many computer installations and commercial enterprises are developing architectures and configurations that can serve as foundations for growth along these lines. An important subclass of local networks is the so-called back-end network. It is characterized by block-oriented traffic, data rates in the multi-megabit range, and functional roles featuring direct access to very large mass storages and interconnection of data base processors. To the extent that data set or file access has a direct effect on processing speed, a properly performing back-end network can provide considerable throughput improvement to a computing installation. 4 figures, 2 tables. (RWR)

10056 (CONF-800868—(Summ.)) Operations Managers Conference. (Department of Energy, Washington, DC (USA). Office of Computer Services and Telecommunications Management). 1980. 66p. NTIS, PC A04/MF A01.

From Managing mass store facilities-AESOP operations managers conference; Chicago, IL, USA (26 Aug 1980).

The theme of the conference was Operations Management Trends, Requirements, Processes, and Problems. Session I, Panel Discussion on Operations Management Trends consisted of three brief presentations on current and future trends in ADP operations. Discussions involved ideas for training operators to perform programming functions; responsibilities of operations managers towards their staffs, training, and user needs; and operations management practices for the past, present, and future. A speech concerning current and future uses of computer graphics was delivered. Session II, Panel Discussion on Managing Mass Storage Facilities, related the current and changing use of mass storage facilities at various laboratory sites. Session III, Panel Discussion on Managing the Data Communications Network, involved brief presentations on how various sites manage data communications. Three speeches concerning the management of data processing output were presented in Session IV, Panel Discussion on Managing Output Processing. These speeches described various methods of providing efficient and cost-effective material for user consumption. Session V involved security, distributed processing, and reliability. Also discussed was the architecture of computer systems and networks and the process involved in the installation of the Amdahl 470/V7A at DOE Headquarters. Session VI, Operations Personnel - the Continuing Challenge, consisted of four speeches describing innovations in scheduling 12-hour shifts, training programs, staffing, and unionization. These reports also addressed the issues of personnel satisfaction, the responsibilities of a training coordinator, and operator skills. Session VII, allowed participants to address additional operations management problems, including DOE Order 1360.2, reproduction capabilities, personnel management, unionization, and the future of stand-alone and package computing systems. (RWR)

10057 (EGG-IS—5287) ISDMS (Release 1.1) (a scientific data management system). Bruestle, H.R.; Russell, K.D.; Snider, D.M.; Stewart, H.D. (Idaho National Engineering Lab., Idaho Falls (USA)). Nov 1980. Contract AC07-76ID01570. 887p. NTIS, PC A99/MF A01.

The Idaho National Engineering Laboratory Scientific Data Management System (ISDMS) is a generalized scientific data processing system designed to meet the needs of the various user groups at the Idaho National Engineering Laboratory (INEL). This system

evolved from the need to consolidate the various data processing activities at the INEL into a common data processing system. This document is intended to serve as an overview of Release 1.1 of ISDMS. Included in this overview are the following: ISDMS historical background, ISDMS design philosophy; ISDMS system description, and ISDMS reference section. The following packages are described in detail: ISDMS environmental library (a collection of relocatable routines), MASTER (interactive/batch executive program), MAGNUM (interactive graphics program), QKPLT (batch graphics program), POST (general plot file post-processor program), FILTER (general digital filter program), COMEDIT (alphanumeric editing program), SEARCH (CWAF file directory and retrieval program), BACKUP/RESTORE (CWAF backup and restore programs), MUX/DEMUX (general data multiplexor/demultiplexor programs), EXPERT (general file manipulation program), WIZARD (general computed parameter program), MERGE (data file copy/merge program), COMSID (CWAF-to-SIDU reformating program), REFORM (general data reformating program), and RELCOM (RELAP4-to-CWAF data reformating program). (RWR)

10058 **(LA—8609-MS) DOE research in utilization of high-performance computers.** Buzbee, B.L.; Worlton, W.J.; Michael, G.; Rodrigue, G. (Los Alamos Scientific Lab., NM (USA); California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1980. Contract W-7405-ENG-36. 15p. NTIS, PC A02/MF A01.

Department of Energy (DOE) and other Government research laboratories depend on high-performance computer systems to accomplish their programatic goals. As the most powerful computer systems become available, they are acquired by these laboratories so that advances can be made in their disciplines. These advances are often the result of added sophistication to numerical models whose execution is made possible by high-performance computer systems. However, high-performance computer systems have become increasingly complex; consequently, it has become increasingly difficult to realize their potential performance. The result is a need for research on issues related to the utilization of these systems. This report gives a brief description of high-performance computers, and then addresses the use of and future needs for high-performance computers within DOE, the growing complexity of applications within DOE, and areas of high-performance computer systems warranting research. 1 figure.

10059 **(SAND—80-2371) Optimal parameters for linear second-degree stationary iterative methods.** Manteuffel, T.A. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1980. Contract AC04-76DP00789. 17p. NTIS, PC A02/MF A01.

It is shown that the optimal parameters for linear second-degree stationary iterative methods applied to nonsymmetric linear systems can be found by solving the same minimax problem used to find optimal parameters for the Tchebychev iteration. In fact, the Tchebychev iteration is asymptotically equivalent to a linear second-degree stationary method. The method of finding optimal parameters for the Tchebychev iteration given by Manteuffel [Numer. Math., 28, 307-27 (1977)] can be used to find optimal parameters for the stationary method as well. 1 figure.

10060 **(SAND—80-2772) Evaluation of a test set for stiff ODE solvers.** Shampine, L.F. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract W-31-109-ENG-38. 32p. NTIS, PC A03/MF A01.

In 1975 Enright, Hull, and Lindberg published a set of problems for the testing of codes for stiff ordinary differential equation (ODE) problems. It has been widely used since then. In this paper a critical evaluation of the test set is made. Changes are recommended that make the set a more useful tool. Comments about the difficulties of testing software in this area are made that lead to more thoughtful use of the test set.

10061 **(SAND—80-2792) SLATEC Common Mathematical Subprogram Library: SNLA implementation.** Haskell, K.H.; Vandevender, W.H.; Walton, E.L. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1980. Contract AC04-76DP00789. 19p. NTIS, PC A02/MF A01.

The SLATEC Common Mathematical Subprogram Library is an inter-laboratory numerical mathematical library among the laboratories SNLA, SNLL, LANSL, AFWL, LLNL, and MFEC. SLATEC is replacing the current Sandia Mathematical Subroutine Library (FXMATH) as the basic math library at SNLA. This report briefly describes the capabilities of the SLATEC library, the method of generating on-line documentation, and the method of accessing the library at SNLA. 3 tables.

10062 **Summation of imprecise numbers.** Metropolis, N. (Los Alamos Scientific Lab., NM). *Computers and Mathematics with Applications (England);* **6**: 297-299(1980).

An algorithm is presented for computer summation of imprecise numbers that may have quite disparate magnitudes and variances. Each number is represented by its expected value and variance. Exact numbers form a subset and are treated in a consistent manner. Cancellation effects are minimized.

9903 Information Handling

10063 **Proceedings of the 27th international technical communications conference.** Washington, DC; Society for Technical Communication (1980). 509p. (STC—103-80(Vol.1); CONF-800509—(Vol.1)).

From 27. international technical communication conference; Bloomington, MN, USA (14 May 1980).

The seventy-six papers presented at the meeting are included in this volume. A separate abstract was prepared for each of 5 papers. Five papers were previously processed for the data base. The remaining 66 papers were not in scope for the data base. (LCL)

10064 **(ORNL/TM—7525) Environmetrics of synfuels. II. A computer-based coding scheme for coal-conversion research data.** Strand, R.H.; Farrell, M.P.; Birchfield, T.K.; Gudmundson, C.W.; Vansuch, M.E.; Polovino, H.N. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 31p. NTIS, PC A03/MF A01.

This report addresses the need to reduce the complexity of data encoding and error rates in studies using multiple data bases composed of hierarchial file structures. It describes a coding scheme to represent long alphanumeric values, indicates the efficiency of such a scheme, and discusses error-rate reduction. Several approaches are available that minimize coding errors. Numeric codes with embedded information allocated to positions within the value codes are widely used, but these are unacceptable for variables with many values or levels of classification. Such smart codes require the full knowledge of the universe the variable describe, as well as the potential classification schemes for each variable. We have found that codes without embedded information (nonsense codes) circumvent the problems associated with smart codes. In addition, experience with several large environmental data bases indicates that coding errors are less frequent using nonsense codes than using smart codes. Since no information is contained in the nonsense code and classification levels are not correlated, there is no tendency for a code recorder to assume that two apparently associated values should code with approximately the same numeric code, when in fact the values are unrelated. Furthermore, little skill is required of the recorder since no hierarchical type of code identification is used - only a simple accession number assignment is required. The use of the FORMAT procedure in the Statistical Analysis System (SAS Institute) and of the nonsense-code approach using variable labelling is presented. The increased storage efficiencies for numerical codes versus long alphanumeric strings are discussed.

10065 **Data-base approach to management of publication lists.** Stefanski, E.M. (Argonne National Lab., IL). pp C.37-C.41 of Proceedings of the 27th international technical communication conference. Washington, DC; Society for Technical Communication (1980).

From 27. international technical communication conference; Bloomington, MN, USA (14 May 1980).

The management of staff publication records can be greatly simplified through the use of either a computer or a word processor with records-management capabilities. These two approaches

are compared with respect to equipment and operating costs, availability of suitable software, and ease of use.

10066 **Text editing on the LLL Octopus.** Lien, P.L. (Lawrence Livermore Lab., CA). pp C.209-C.212 of Proceedings of the 27th international technical communication conference. Washington, DC; Society for Technical Communication (1980).

From 27. international technical communication conference; Bloomington, MN, USA (14 May 1980).

Editors in the computer-documentation group at LLL do most of their work online. The Livermore timesharing computer system - nicknamed the Octopus - is one of the world's largest concentrations of computing power and information-storage capacity. The programs used for text editing and formatting, as well as the distribution options available for the finished documents are described. Also examples are given of some of the special things editors can do using the Octopus (e.g., generating equations and figures).

10067 **Sensational viewgraphs: the do-it-yourself variety.** Hamilton, W.E. (Lawrence Livermore Lab., CA). pp G.17-G.25 of Proceedings of the 27th international technical communication conference. Washington, DC; Society for Technical Communication (1980).

From 27. international technical communication conference; Bloomington, MN, USA (14 May 1980).

Viewgraphs are common visual aids in today's meetings and conferences. This is particularly evident at presentations in large companies. Viewgraphs are prepared to many different standards by engineers, scientists, editors, secretaries, and by professional artists. This paper is directed to nonprofessional viewgraph makers. Guidelines are provided to assist one to produce sensational do-it-yourself viewgraphs by selecting and using the materials necessary to produce a finished job as well as by using illustrations, established design criteria, and a visually appealing art style.

10068 **High-quality computer graphics for publications.** Dean, P.W. (Sandia Labs., Livermore, CA). pp G.53-G.62 of Proceedings of the 27th international technical communication conference. Washington, DC; Society for Technical Communication (1980).

From 27. international technical communication conference; Bloomington, MN, USA (14 May 1980).

At Sandia Laboratories, Livermore, the technical illustrators and publication personnel have joined with the computer graphics staff to create computer programs capable of producing high-quality charts and graphs that can be used not only as report illustrations but which will also serve equally well as projection transparencies and journal illustrations. The experience has been educational - both for the illustrators, who have learned that computers impose limitations that must be dealt with; and for the programmers, who have discovered the impact that proper line weight, letter size and style, and overall proportions can have on the readability and impact of illustrations.

10069 **Techniques for honing production.** Genin, M.S. (Lawrence Livermore Lab., CA). pp M.9-M.13 of Proceedings of the 27th international technical communication conference. Washington, DC; Society for Technical Communication (1980).

From 27. international technical communication conference; Bloomington, MN, USA (14 May 1980).

The procedures used in the Technical Information Division of Lawrence Livermore Laboratory for producing and keeping track of reports and the innovations used to expedite these activities are discussed. (LCL)

10070 **Proceedings of the 27th international technical communication conference.** Washington, DC; Society for Technical Communication (1980). 541p. (STC—103-80(Vol.2); CONF-800509—(Vol.2)).

From 27. international technical communication conference; Bloomington, MN, USA (14 May 1980).

The eighty-nine papers presented at the meeting are included in this volume. A separate abstract was prepared for each of 4 papers. The remaining 85 papers were not in scope for the data base. (LCL)

10071 **Coping with crash editing .** Jarman, B.B. (Lawrence Livermore Lab., CA). pp W.9-W.12 of Proceedings of the 27th international technical communication conference. Washington, DC; Society for Technical Communication (1980).

From 27. international technical communication conference; Bloomington, MN, USA (14 May 1980).

Crash editing, i.e., editing a manuscript quickly to meet an almost immediate deadline, is described in three main steps; psyching up, attacking the manuscript, and trading off quality with time in order to meet a deadline. These steps enable an editor to cope objectively with the demands on his ability and utilization of time. Tables and matrices are included which enable the editor, on the basis of his own editing speed, to choose the level of editing that best fits the time he has available for editing a particular sized manuscript.

10072 **Get in the habit of editing illustrations.** Amsden, D.C. (Los Alamos National Scientific Lab., NM). pp W.147-W.154 of Proceedings of the 27th international technical communication conference. Washington, DC; Society for Technical Communication (1980).

From 27. international technical communication conference; Bloomington, MN, USA (14 May 1980).

Editing illustrations can become habit-forming once you get started. The payoff is a cohesive document with art and text that reinforce one another. To reach that goal, you have to consider the function of all the illustrations in a document and determine the appropriate level of detail for each one. Then rework the individual illustrations. Once they have been inked, you have a further obligation to size them properly for inclusion with the text. Guidelines to help technical editors address these considerations are presented.

10073 **Formal table talk.** Griffith, G.W. (Oak Ridge National Lab., TN). pp W.155-W.157 of Proceedings of the 27th international technical communication conference. Washington, DC; Society for Technical Communication (1980).

From 27. international technical communication conference; Bloomington, MN, USA (14 May 1980).

The correct use of tables has three requirements: the text must have a specific relationship to the tables; the tables must have a specific relationship with the text; and the tables must be structured correctly.

10074 **Generative grammer: the rules of English.** Schulman, N.J. (Union Carbide Nuclear Division, Oak Ridge, TN). pp W.209-W.211 of Proceedings of the 27th international technical communication conference. Washington, DC; Society for Technical Communication (1980).

From 27. international technical communication conference; Bloomington, MN, USA (14 May 1980).

The development of traditional grammar and of new or transformation-generative grammer is discussed. (LCL)

10075 **(DOE/TIC—4608) Energy data base: subject coverage, literature coverage, data elements, and indexing practices.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). [nd]. 26p. TIC.

A booklet, designed to acquaint readers with the general characteristics of EDB and to provide basic information regarding the data base, its structure, and its features, is presented. Among the topics discussed are: subjects covered in the EDB, types of documents included as EDB references, identification data recorded for the EDB references, etc. Also included is a list of publications that give more detailed information on these and other aspects of EDB. Each document listed is described briefly, and the source from which the document can be obtained is given.

9905 Civilian Defense

REFER ALSO TO CITATION(S) 8723

10076 **(AD-A—083345) Development and application of a model of fallout shelter stay times. Final report, 15 June-19 December 1978.** Kinrich, J.H.; Levit, R.A.; Maresca, N.J. (BDM Corp., Vienna, VA (USA)). 29 Dec 1978. Contract DNA001-78-C-0060. 103p. NTIS, PC A06/MF A01.

The Attrition Rate Model is a model of how and at what rate individuals leave fallout shelters. This document is a description of the model and the methodology used to develop it. In addition, this document serves as a user's guide to the application of the model. Two complete examples are presented--a pencil-and-paper study of fallout casualties in a representative Soviet city, and an application to a red-on-blue SIDAC scenario. The complete programs necessary to run the SIDAC post-processor are also included.

10077 **(AD-A—085024) Shelter upgrading manual: host area shelters. Final report.** Wilton, C.; Gabrielsen, B.L.; Tansley, R.S. (Scientific Service, Inc., Redwood City, CA (USA)). Mar 1980. Contract DCPA01-78-C-0215. 248p. NTIS, PC A11/MF A01.

The manual is one of a series being developed in support of the civil defense concept of crisis relocation planning. One basic element of crisis relocation is shelter protection of the people in the relocated environment. This manual is designed to be used by planners in host areas. It presents a methodology for evaluating floors, roofs, and openings; develops a variety of ways to provide the necessary structural upgrading for blast and fallout protection; develops a framework for the practical use of the manual by all persons of interest; and contains charts, pictorial representations, and worksheets that complement and simplify the utility of the manual. The manual is in looseleaf form to permit removal of pertinent worksheets and charts for developing upgrading plans for a specific building, and to permit the addition of new and replacement material as the work progresses.

10078 **(AD-A—085165) Study of fallout shelter ventilation kit placement design. Final report, September 1978-May 1980.** York, S.B. III; Armstrong, J.G. (Research Triangle Inst., Research Triangle Park, NC (USA). Operations Analysis Dept.). May 1980. Contract DCPA01-78-C-0318. 197p. NTIS, PC A09/MF A01.

This study consisted of an investigation into several aspects of providing ventilation in host-area fallout shelter facilities. A stepwise procedure for allocating ventilation equipment to host-area shelter facilities and for deploying the equipment within each facility was developed. Example deployment plans for numerous shelter story configurations and sizes are included as an appendix. Another appendix contains examples in the use of the stepwise procedure to allocate ventilation equipment to deploy the equipment within six specific shelter facilities. In addition, alternative systems for distributing shelter supplies from the host-area county seat to individual shelter facilities were evaluated. Analysis of alternative distribution methods in the Macon, Georgia, and Utica-Rome, New York,host areas indicated that the one truck per shelter facility loaded on the basis of the largest facility first priority method generally should be favored. The logistics involved in implementing this method and the advance planning required were discussed.

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

A

Academia Sinica, Bejing (China)
Conduction cooling: multicrate fastbus hardware, 6:9151 (BNL—28664)

Acurex Corp., Mountain View, CA (USA). Alternate Energy Div.
Solar production of industrial process hot water: operation and evaluation of the Campbell Soup hot water solar facility. Final report, September 1, 1979-December 10, 1980, 6:8939 (SAN—1218-4)

Advanced Mechanical Technology, Inc., Newton, MA (USA)
Research and development of a high efficiency gas-fired water heater. Volume 1. Final report summary, 6:9285 (ORNL/Sub—7381/1)
Research and development of a high efficiency gas-fired water heater. Volume 2. Task reports, 6:9286 (ORNL/Sub—7381/2)

Aerospace Corp., El Segundo, CA (USA)
Nucleosynthesis of neutron-rich heavy nuclei during explosive helium burning in massive stars, 6:9789 (DOE/TIC—11391)

Aerospace Corp., El Segundo, CA (USA). Chemistry and Physics Lab.
A study of aircraft NiCd battery state-of-charge measurement by phase meter. Interim report, 6:9177 (AD-A—084935)
Phase meter measurement of state of charge for satellite NiCd cells: a preliminary study. Interim report, 6:9176 (AD-A—084907)

Aerospace Corp., El Segundo, CA (USA). Energy and Resources Div.
Photovoltaic mission analysis. Program summary report, 15 August 1978-28 February 1979, 6:8827 (ATR—79(7694-07)-3)

AiResearch Mfg. Co., Los Angeles, CA (USA)
Heat exchanger fouling and corrosion evaluation. Phase 1, topical report exhibit III-B, 6:9406 (DOE/ET/11296—T16)

Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering
Documentation and analysis of the WSEG-10 fallout prediction model. Master's thesis, 6:9636 (AD-A—083515)
LOWTHRM: a thermal fluence code. Master's thesis, 6:9592 (AD-A—083520)

Alberta Univ., Edmonton (Canada)
Enhanced ignition for I.C. engines with premixed charge, 6:9369 (LBL—11880)

Allied-General Nuclear Services, Barnwell, SC (USA)
Spent fuel disassembly and canning programs at the Barnwell Nuclear Fuel Plant (BNFP), 6:8640 (AGNS—35900-1.2-104)

American Association for the Advancement of Science, Washington, DC
Carbon Dioxide Effects Research and Assessment Program. Environmental and societal consequences of a possible CO_2-induced climate change: a research agenda, 6:9190 (DOE/EV/10019—01(Vol.1))

American Heliothermal Corp., Denver, CO
Evaluation of solar collectors for heat pump applications. Final report, 6:8931 (DOE/CS/35351—T1)

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., New York
Parallel calculations between the TC 4.7 simplified energy calculation procedure and seven comprehensive hourly simulation energy calculation procedures, 6:9277 (DOE/CS/20057—T2)

American Univ., Washington, DC
Definition of chemical and electrochemical properties of a fuel cell electrolyte. Interim technical report, 24 July 1978-24 December 1979, 6:9250 (AD-A—083608)

Ames Lab., IA (USA)
Alloy evaluation for fossil fuel process plants (liquefaction). Annual report, 1 October 1979-30 September 1980, 6:8539 (IS—4758)
Preparation of high purity vanadium, 6:9409 (IS-M—305)

Anacapa Sciences, Inc., Santa Barbara, CA (USA)
Human factors analysis and design methods for nuclear waste retrieval systems. Human factors design methodology and integration plan, 6:8674 (UCRL—15297(Vol.1))

Argonne National Lab., IL (USA)
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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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AC05-79ET14503	**Conoco Coal Development Co., Library, PA (USA). Research Div.**	
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AC06-76ER01388	**Washington Univ., Seattle (USA)**	
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AC06-76RL01830	**Battelle Pacific Northwest Labs., Richland, WA (USA)**	
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AC06-77ET20280	**Science Applications, Inc., La Jolla, CA (USA)**	
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AC06-77RL01030	**Foundation Sciences, Inc., Portland, OR (USA)**	
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AC06-77RL01830	**Rockwell International Corp., Richland, WA (USA). Energy Systems Group**	
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AC06-80ER53098	**Mathematical Sciences Northwest, Inc., Bellevue, WA (USA)**	
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AC07-76ID01570	**EG and G Idaho, Inc., Idaho Falls (USA)**	
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AC07-77CS40012	**Terra Tek, Inc., Salt Lake City, UT (USA)**	
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AC07-78ET10816	**Montana Energy and MHD Research and Development Inst., Inc., Butte (USA)**	
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AC07-79ET27002	**Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics**	
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AC07-79ID01675	**Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)**	
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AC07-79ID12079	**Utah Univ., Salt Lake City (USA). Research Inst.**	
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AC08-76DP00099	**URS/John A. Blume and Associates, Engineers, San Francisco, CA (USA)**	
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AC08-76NV01183	**EG and G, Inc., Las Vegas, NV (USA). Energy Measurements Group**	
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AC08-78DP40030	**KMS Fusion, Inc., Ann Arbor, MI (USA)**	
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AC08-79BC10003	**CER Corp., Las Vegas, NV (USA)**	
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AC08-79DP40116	**TRW Defense and Space Systems Group, Redondo Beach, CA (USA)**	
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AC09-76SR0001	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.**	
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AC09-78ET35900	**Allied-General Nuclear Services, Barnwell, SC (USA)**	
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AC0O2-79ET34006	**Exxon Nuclear Co., Inc., Richland, WA (USA)**	
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AC11-76PN00014	**Bettis Atomic Power Lab., West Mifflin, PA (USA)**	
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AC13-76GJ01664	**Research Associates of Wyoming, Casper (USA)**	
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AC13-79GJ01692	**High Life Helicopters, Inc., Puyallup, WA (USA)**	
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AC20-79LC10003	**JAYCOR, Del Mar, CA (USA)**	
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AC21-76ET12121	**Indiana Geological Survey, Bloomington (USA)**	
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AC21-77MC08087	**West Virginia Univ., Morgantown (USA)**	
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AC21-78MC08089	**TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.**	
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AC21-79MC11842	**State Univ. of New York, Buffalo (USA)**	
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AC22-79PC20023	**Pittsburgh Univ., PA (USA)**	
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AC22-80PC30088	**Chicago Univ., IL (USA)**	
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AI01-76ET12548	**Jet Propulsion Lab., Pasadena, CA (USA)**	
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AI01-76ET20191	**LaQuinta Motor Inns, Inc., San Antonio, TX (USA)**	
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AI01-76EV03201	**Water Resources Council, Washington, DC (USA)**	
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AI01-77CS20460	**National Engineering Lab. (NBS), Washington, DC (USA)**	
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AI01-77DP40042	**Naval Research Lab., Washington, DC (USA)**	
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AI01-77ET10350	**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**	
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AI01-77ET10769	**Burns and Roe, Inc., Woodbury, NY (USA)**	
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AI01-77ET11272	**ECO, Inc., Cambridge, MA (USA)**	
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AI01-77ET20401	**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**	
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AI01-77ET26203	**Jet Propulsion Lab., Pasadena, CA (USA)**	
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AI01-79ER10035	**National Aeronautics and Space Administration, Washington, DC (USA)**	
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AI01-80CS80010	**Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Agricultural Development**	
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AI01-80ER10160	**SRI International, Menlo Park, CA (USA)**	
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AM01-80ET13650	**Meyer (A.F.) and Associates, Inc., McLean, VA (USA)**	
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AM21-78MC08333	**Science Applications, Inc., McLean, VA (USA)**	
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AP01-79RA23104	**Massachusetts Executive Office of Energy Resources, Boston (USA)**	
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AP03-80SF10951	**Kando (Paul F.), Inc., Washington, DC (USA)**	
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AP03-80SF12989	**Technical Research Analysis Co., Falls Church, VA (USA)**	
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AS02-76ER02439	**State Univ. of New York, Albany (USA). Dept. of Physics**	
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AS02-76ER02875	**Purdue Univ., Lafayette, IN (USA). Dept. of Physics**	
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AS02-76ER02887	**Harvard Coll. Observatory, Cambridge, MA (USA)**	
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AS02-76ET52002	**Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center**	
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AS02-76ET52040	**Illinois Univ., Urbana (USA). Fusion Studies Lab.**	
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AS02-76ET53051	**Wisconsin Univ., Madison (USA). Dept. of Physics**	
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AS02-76EV02502	**State Univ. of New York, Buffalo (USA). Dept. of Biology**	
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AS02-76EV02758	**Missouri Univ., Columbia (USA)**	
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AS02-76EV03040	**New York Univ., NY (USA). Inst. of Environmental Medicine**	
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AS02-76EV03267	**Jackson Lab., Bar Harbor, ME (USA)**	
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AS02-76EV12529	**Columbia Univ., Palisades, NY (USA). Lamont-Doherty Geological Observatory**	
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AS02-77ER04215	**Minnesota Univ., Minneapolis (USA). School of Physics**	
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AS02-77ET28357	**Massachusetts Inst. of Tech., Cambridge (USA)**	
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AS02-78CS40064	**Maine Univ., Orono (USA)**	
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AS02-78ER04988	**Massachusetts Inst. of Tech., Cambridge (USA)**	
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AS02-78ER05006	**Department of Energy, Washington, DC (USA). Div. of Chemical Sciences**	
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AS02-78ET52048	**Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering**	
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AS02-78EV04746	**Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Radiology**	
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AS02-78EV04964	**Pennsylvania State Univ., University Park (USA)**	
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AS02-79ER10440	**Washington Univ., St. Louis, MO (USA). Dept. of Physics**	
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AS04-77ET04096	**Arkansas Univ., Fayetteville (USA). Coll. of Engineering**	
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AS05-76ER01797	**Florida State Univ., Tallahassee (USA). Dept. of Chemistry**	
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AS05-76ER03898	**Texas A and M Univ., College Station (USA). Research Foundation**	
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AS05-79ER10332	**George Washington Univ., Washington, DC (USA)**	
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AS05-79ER10348	**Tennessee Univ., Knoxville (USA)**	
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AS06-77ET28476	**Oregon Inst. of Tech., Klamath Falls (USA). Geo-Heat Utilization Center**	
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AS07-76ID01523	**Utah Univ., Salt Lake City (USA). Dept. of Mechanical Engineering**	
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AS21-76ET12014	**New York State Museum and Science Service, Albany (USA)**	
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AS21-76ET12104	**New York State Museum and Science Service, Albany (USA)**	
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AS22-78ET00222	**Cincinnati Univ., OH (USA). Dept. of Environmental Health**	
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AT01-76CS51011	**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**	
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AT01-76ET10696	**Massachusetts Inst. of Tech., Cambridge (USA)**	
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AT03-76ER70129	**SRI International, Menlo Park, CA (USA). Materials Research Lab.**	
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AT03-76ET30351	**Aerospace Corp., El Segundo, CA (USA). Energy and Resources Div.**	
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AT03-76SF20235	**Hawaii Univ., Honolulu (USA). James K.K. Look Lab. of Oceanographic Engineering**	
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AT06-76EV70003	**Montana State Univ., Bozeman (USA). Dept. of Animal and Range Sciences**	
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AT06-76EV72002	**Washington State Univ., Pullman (USA). Dept. of Agronomy and Soils**	
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AT06-79EV10004	**Oregon State Univ., Corvallis (USA). Dept. of Fisheries and Wildlife**	
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EY-76-C-06-1830	**Battelle Pacific Northwest Labs., Richland, WA (USA)**	
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FG02-79R510107	**Illinois Univ., Urbana (USA). Dept. of Agricultural Engineering**	
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FG02-79R510130	**Johnson (Jay M.), Excelsior, MN (USA)**	
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FG03-76CS31084	**California Univ., Los Angeles (USA). School of Engineering and Applied Science**	
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FG03-78CS20028	**Energy Development Board of Mercer County, Hazen, ND (USA)**	
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FG03-79SF10754	**Claremont Graduate School, CA (USA). Dept. of Mathematics**	
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FG03-80IR11125	**Granzow Communications, Washington, DC (USA)**	
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FG05-780RO6080	**Virginia Univ., Charlottesville (USA). Research Labs. for the Engineering Sciences**	
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FG06-79ET27256	**Oregon Inst. of Tech., Klamath Falls (USA). Geo-Heat Utilization Center**	
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FG51-80RA50083	**Idaho State Government, Boise (USA)**	
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NAS-7-100-954589	**Westinghouse Electric Corp., Trafford, PA (USA). Power Circuit Breaker Div.**	
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NAS-7-100-955342	**RCA Solid State Div., Somerville, NJ (USA)**	
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CONF-800120-	(Conference on theoretical particle physics, Guangchou, China, 5-14 Jan 1980)	
6	6:9868	NTIS, PC A02/MF A01
CONF-800131-	(Nuclear structure with intermediate energy probes workshop, Los Alamos, NM, USA, 14-17 Jan 1980)	
	6:9874	*See* LA-8303-C
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	6:9943	*See* LA-8303-C
CONF-800153-	(Meeting of the Oregon section American Nuclear Society, Salem, OR, USA, 16 Jan 1980)	
1	6:8644	*See* RHO-BWI-SA-42
CONF-800157-	(Nevada applied ecology group (NAEG) information meeting, Las Vegas, NV, USA, 29-30 Jan 1980)	
1	6:8662	*See* PNL-SA-8267
2	6:9658	*See* PNL-SA-8268
CONF-800231-	(3. international conference on nondestructive evaluation in the nuclear industry, Salt Lake City, UT, USA, 11-13 Feb 1980)	
3	6:9152	*See* PNL-SA-8090
CONF-800264-	(24. American Public Power Association annual engineering and operations workshop, Phoenix, AZ, USA, 25-28 Feb 1980)	
2	6:8571	Library, American Public Power Association, Washington, DC, $3.00
3	6:9117	$3.00
8	6:9617	NTIS, PC A02/MF A01
13	6:9764	American Public Power Association, Washington, DC
CONF-800353-	(World gas option symposium, Washington, DC, USA, 26-28 Mar 1980)	
	6:8611	$25.00
CONF-8003115-	(Some aspects of the role of the shallow ocean in global carbon dioxide uptake conference, Atlanta, GA, USA, 20-22 Mar 1980)	
	6:9618	NTIS, PC A04/MF A01
CONF-800419-	(5. symposium on automotive propulsion systems, Dearborn, MI, USA, 14-18 Apr 1980)	
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CONF-800420-	(2. international ocean disposal symposium, Woods Hole, MA, USA, 15-18 Apr 1980)	
5	6:8672	*See* SAND-80-2346C
CONF-800444-	(2. technical meeting on the nuclear transmutation of actinides, Ispra, Italy, 21-24 Apr 1980)	
2	6:8663	*See* PNL-SA-8491
CONF-800471-	(Seminar on theory and applications of Monte Carlo methods, Oak Ridge, TN, USA, Apr 1980)	
	6:9133	*See* ORNL/RSIC-44
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CONF-800484-	(Reversed field pinch theory workshop, Los Alamos, NM, USA, 28 Apr-2 May 1980)	
10	6:9980	*See* LA-UR-80-3409
11	6:10022	*See* LA-UR-80-3408
CONF-800509-	(27. international technical communication conference, Bloomington, MN, USA, 14-17 May 1980)	
(Vol.1)	6:10063	Washington, DC; Society for Technical Communication (1980).
(Vol.2)	6:10070	Washington, DC; Society for Technical Communication (1980).
CONF-800588-	(International symposium on high energy e+-e- interactions, Nashville, TN, USA. 1-3 May 1980)	
	6:9846	Schenectady, NY; American Institute of Physics (1980).
CONF-8005102-	(Seminar on the beam-beam interaction, Stanford, CA, USA, 22-23 May 1980)	
	6:9531	*See* SLAC-PUB-2624
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1	6:8538	*See* FE-2566-43
CONF-8005134-	(Conference on pollen systems to detect biological activity of environmental pollutants, Knoxville, TN, USA, 6-8 May 1980)	
2	6:9699	*See* DOE/EV/72002-49
CONF-8006127-	(International conference on interacting bose-fermi systems in nuclei, Erice, Sicily, Italy, 12-19 Jun 1980)	
3	6:9929	*See* LA-UR-80-3475
4	6:9930	*See* LA-UR-80-3476
CONF-8006142-	(ACRS metal component subcommittee for reactor safety meeting, Washington, DC, USA, 17 Jun 1980)	
1	6:9163	*See* PNL-SA-8691
CONF-8006150-	(DOE meeting on ion implantation and zeloyte encapsulation technologies for immobilization of krypton-85, La Jolla, CA, USA, 17-19 Jun 1980)	
1	6:9807	*See* PNL-SA-8661
CONF-800723-	(19. national heat transfer conference, Orlando, FL, USA, 27-30 Jul 1980)	
25	6:9503	*See* BDX-613-2445
CONF-800740-	(11. international conference on high energy accelerators, Geneva, Switzerland, 7-11 Jul 1980)	
25	6:9551	*See* LBL-10756
26	6:9530	*See* LBL-10753
CONF-800743-	(International conference on nuclear waste transmutation, Austin, TX, USA, 22-24 Jul 1980)	
14	6:9546	*See* BNL-28779
CONF-800751-	(Workshop on thermomechanical-hydrochemical modeling for hardrock waste repository, Bereley, CA, USA, 29-31 Jul 1980)	
4	6:8664	*See* RHO-BWI-SA-82
CONF-800814-	(180. American Chemical Society meeting/2. chemical congress of the North American Continent, Las Vegas, NV, USA, 24-29 Aug 1980)	
30	6:9102	*See* LBL-11586
CONF-800827-	(3. international conference on photochemical conversion and storage of solar energy, Golden, CO, USA, 3-8 Aug 1980)	
4	6:8781	*See* SERI/TP-623-1045
CONF-800868-	(Managing mass store facilities-AESOP operations managers conference, Chicago, IL, USA, 26-28 Aug 1980)	
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CONF-800877-	(3. international conference on NTD-silicon, Copenhagen, Denmark, 27-29 Aug 1980)	
2	6:9450	*See* LA-UR-80-3533
CONF-800881-	(Conference on modeling of casting and welding processes, Runge, NH, USA, Aug 1980)	
2	6:9413	*See* SAND-80-1177C
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1(Rev.1)	6:8620	*See* UCRL-84048(Rev.1)
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3	6:8621	*See* UCRL-84913
CONF-800950-	(11. symposium on fusion technology, Oxford, UK, 15-19 Sep 1980)	
17	6:10030	*See* LBL-11839
CONF-800952-	(International conference on charged particle optics, Giessen, F.R. Germany, 8-12 Sep 1980)	
4	6:9571	*See* SLAC-PUB-2370
CONF-800964-	(National symposium on the use of cesium-137 to process sludge for further reduction of pathogens, Denver, CO, USA, 3-4 Sep 1980)	
	6:8715	*See* SAND-80-2744
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	6:9727	*See* SAND-80-2744
CONF-800979-	(Workshop on nuclear data evaluation methods and procedures, Upton, NY, USA, 22-25 Sep 1980)	
12	6:9972	*See* COO-2218-195
CONF-800980-	(Applied superconductivity conference, Santa Fe, NM, USA, 29 Sep-2 Oct 1980)	
35	6:9504	*See* LBL-11605
CONF-800995-	(Western SUN 1980 solar update conference, Salt Lake City, UT, USA, 24-26 Sep 1980)	
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CONF-8009121-	(International workshop on radionuclide scenarios for geologic repositories, Paris, France, 8-12 Sep 1980)	
1	6:8665	*See* RHO-BWI-SA-83
CONF-8009124-	(Repository sealing field testing workshop, Santa Fe, NM, USA, 18-19 Sep 1980)	
1	6:9782	*See* UCRL-85231
CONF-8009126-	(Conference on the relation of environmental pollution to the cancer problem, Lakewood, CO, USA, Sep 1980)	
1	6:9723	*See* LA-UR-80-3669
CONF-801037-	(American Vacuum Society conference, Detroit, MI, USA, 13-17 Oct 1980)	
26	6:8691	*See* KMSF-U-1008
27	6:8696	*See* KMSF-U-1019
28	6:8694	*See* KMSF-U-1014
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33	6:8689	*See* KMSF-U-1004
34	6:8690	*See* KMSF-U-1007
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36	6:8692	*See* KMSF-U-1010
37	6:9979	*See* GA-A-16034
CONF-801045-	(DOE statistical symposium, Berkeley, CA, USA, 29-31 Oct 1980)	
5	6:8671	*See* SAND-80-2017C
7	6:9168	*See* UCRL-84157
CONF-801054-	(Institute for Reactor Safety meeting, Munich, F.R. Germany, 31 Oct 1980)	
1	6:9569	*See* LBL-11818
CONF-801068-	(2. international symposium on the production and neutralization of negative hydrogen ions and beams, Upton, NY, USA, 6 Oct 1980)	
16	6:9552	*See* LBL-11639
17	6:10025	*See* LBL-11635
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CONF-801074-	(8. annual DOE compatibility meeting, Los Alamos, NM, USA, 14-16 Oct 1980)	
2	6:9578	*See* MLM-2798(OP)
CONF-8010104-	(Western states section of the combustion institute fall 1980 meeting, Los Angeles, CA, USA, 20-21 Oct 1980)	
4	6:8711	*See* SAND-80-8804
CONF-8010115-	(MARIA workshop on accelerator systems for relativistic heavy ions in medical and scientific research, Edmonton, Alberta, Canada, 20-24 Oct 1980)	
3	6:9553	*See* LBL-11808
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4	6:9627	*See* LBL-11676
CONF-8010149-	(Function of quinones in energy conserving systems conference, Hanover, NH, USA, 26-29 Oct 1980)	
1	6:9688	*See* BNL-28684
CONF-8010152-	(International Association of Energy Economists conference, Washington, DC, USA, 5-7 Oct 1980)	
1	6:9225	*See* LBL-11903
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1	6:9704	*See* LA-UR-80-3699
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41	6:9559	*See* LBL-10726
42	6:9560	*See* LBL-11766
43	6:8557	*See* UCRL-85101
44	6:9568	*See* LBL-11036
45	6:9705	*See* LBL-11037
47	6:9557	*See* BNL-28850
48	6:9151	*See* BNL-28664
49	6:9558	*See* COO-3072-119
CONF-801104-	(73. annual meeting of the American Institute of Chemical Engineers, Chicago, IL, USA, 12-16 Nov 1980)	
11	6:8577	Chicago, IL; Institute of Gas Technology (1980).
CONF-801107-	(ANS international conference, Washington, DC, USA, 17-21 Nov 1980)	
61	6:8648	NTIS, PC A02/MF A01
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37	6:9805	*See* LBL-11779
38	6:10018	*See* GA-A-16085
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39	6:8645	*See* SAND-80-1804C
CONF-801124-	(3. annual meeting of the Materials Research Society, Boston, MA, USA, 17-20 Nov 1980)	
39	6:9956	*See* SAND-80-2860C
40	6:9430	*See* BNL-28714
CONF-801134-	(26. annual conference on magnetism and magnetic metals, Dallas, TX, USA, 11-14 Nov 1980)	
13	6:9411	*See* LBL-11680
CONF-801138-	(Electromagnetic guns and launchers conference, San Diego, CA, USA, 4-6 Nov 1980)	
7	6:9550	*See* LA-UR-80-3507
CONF-801142-	(3. international coal utilization exhibition and conference, Houston, TX, USA, 18-20 Nov 1980)	
4	6:8552	Chicago, IL; Institute of Gas Technology (1980).
CONF-801160-	(Symposium and workshop on the Mount St. Helens eruption, Washington, DC, USA, 18-21 Nov 1980)	
2	6:9625	*See* LA-UR-81-110
CONF-801171-	(7. national conference on energy and the environment, Phoenix, AZ, USA, 30 Nov-3 Dec 1980)	
1	6:8782	*See* SERI/TP-743-1027
CONF-801201-	(3. international conference on lasers and applications, New Orleans, LA, USA, 15-19 Dec 1980)	
3	6:9799	*See* LA-UR-80-3674
4	6:9487	*See* LA-UR-80-3459
5	6:10024	*See* LA-UR-80-3703
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5	6:8678	*See* LA-UR-80-3468
8	6:8673	*See* SAND-80-2574C
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15	6:10014	*See* COO-2218-199
16	6:9499	*See* LA-UR-80-3585
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9	6:9973	*See* COO-2218-197
10	6:9974	*See* COO-2218-198
11	6:10023	*See* LA-UR-80-3494

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2	6:8938	*See* LA-UR-80-3473
3	6:8930	*See* DOE/CS/34127-1
4	6:8937	*See* LA-UR-80-3453
CONF-801226-	(American Chemical Society southeast-southwest regional meeting, New Orleans, LA, USA, 10-13 Dec 1980)	
3	6:8553	NTIS, PC A02/MF A01
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2	6:9087	*See* LA-UR-80-3496
CONF-801239-	(46. Military Operations Research Society meeting, Newport, RI, USA, 2-4 Dec 1980)	
1	6:9220	*See* LA-UR-80-3445
CONF-810101-	(American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) meeting, Chicago, IL, USA, 25-29 Jan 1981)	
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5	6:9274	NTIS, PC A03/MF A01
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1	6:9089	*See* LA-UR-80-3604
2	6:9088	*See* LA-UR-80-3586
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1	6:9255	*See* DOE/NASA/11272-2
2	6:9526	*See* UCRL-84519
3	6:9828	*See* UCRL-84559
CONF-810107-	(2. international conference on recent progress in many-body theories, Mexico City, Mexico, 12-16 Jan 1981)	
1	6:9944	*See* LA-UR-80-3658
CONF-810108-	(5. annual conference on composites and advanced materials, Cocoa Beach, FL, USA, 18-22 Jan 1981)	
1	6:9523	*See* MLM-2796(OP)
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1	6:10055	*See* BNL-28175
CONF-810203-	(Extraction metallurgy of refractory metals meeting, Chicago, IL, USA, 22-26 Feb 1981)	
1	6:9409	*See* IS-M-305
CONF-810204-	(SPIE symposium on high-power lasers and applications, North Hollywood, CA, USA, 11-13 Feb 1981)	
1	6:9517	*See* LA-UR-80-3621
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1	6:9144	*See* LA-UR-80-3592
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1	6:8848	*See* DOE/NASA/1060-4
2	6:9378	*See* DOE/NASA/1044-12
3	6:9369	*See* LBL-11880
4	6:9398	*See* LA-UR-80-3491
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2	6:9432	*See* GA-A-16054
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1	6:9414	*See* UCRL-84976
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1	6:9632	*See* UCRL-84352
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2	6:9623	*See* DP-MS-80-69
3	6:9641	*See* DP-MS-80-53
5	6:9597	*See* BNL-28555
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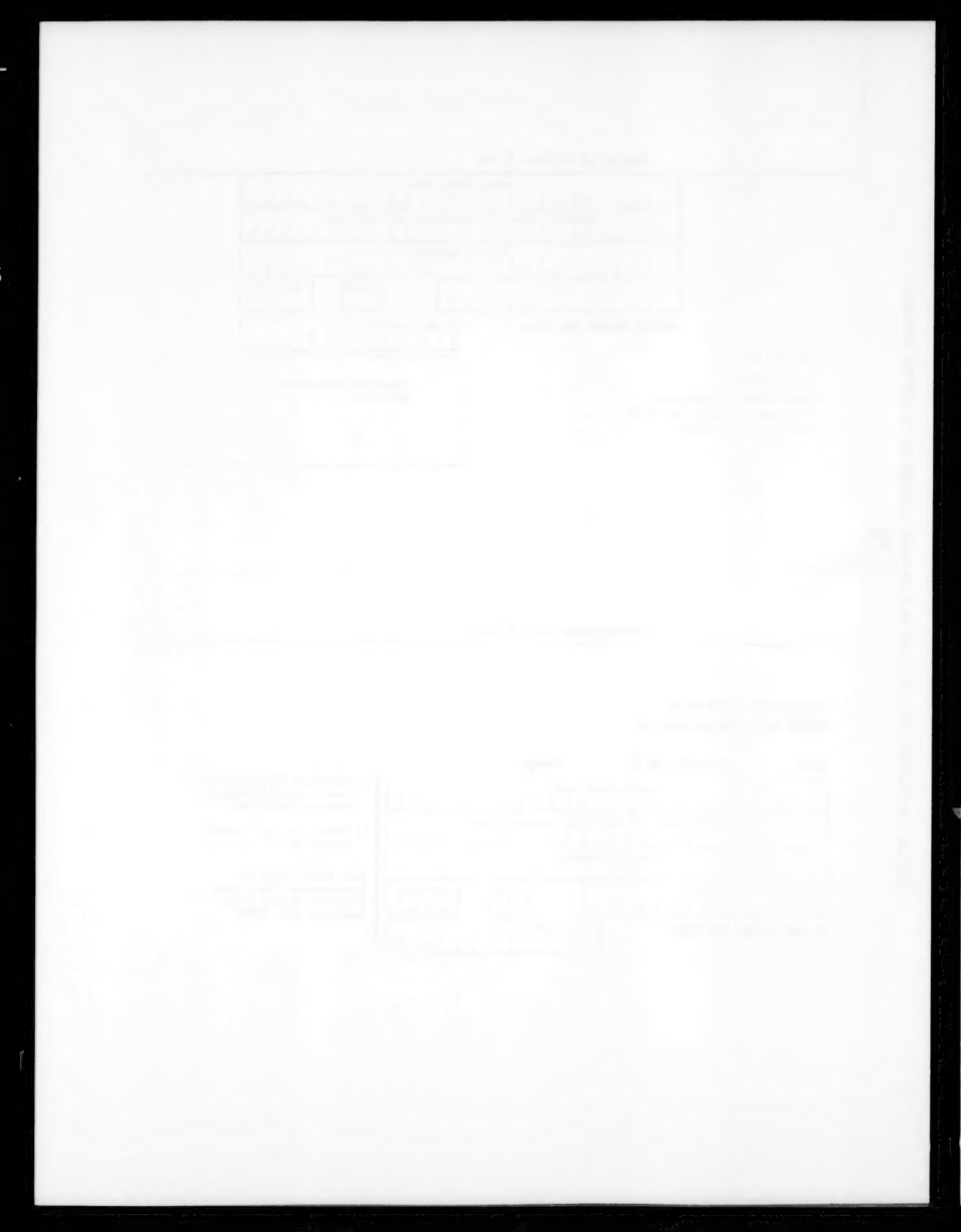

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